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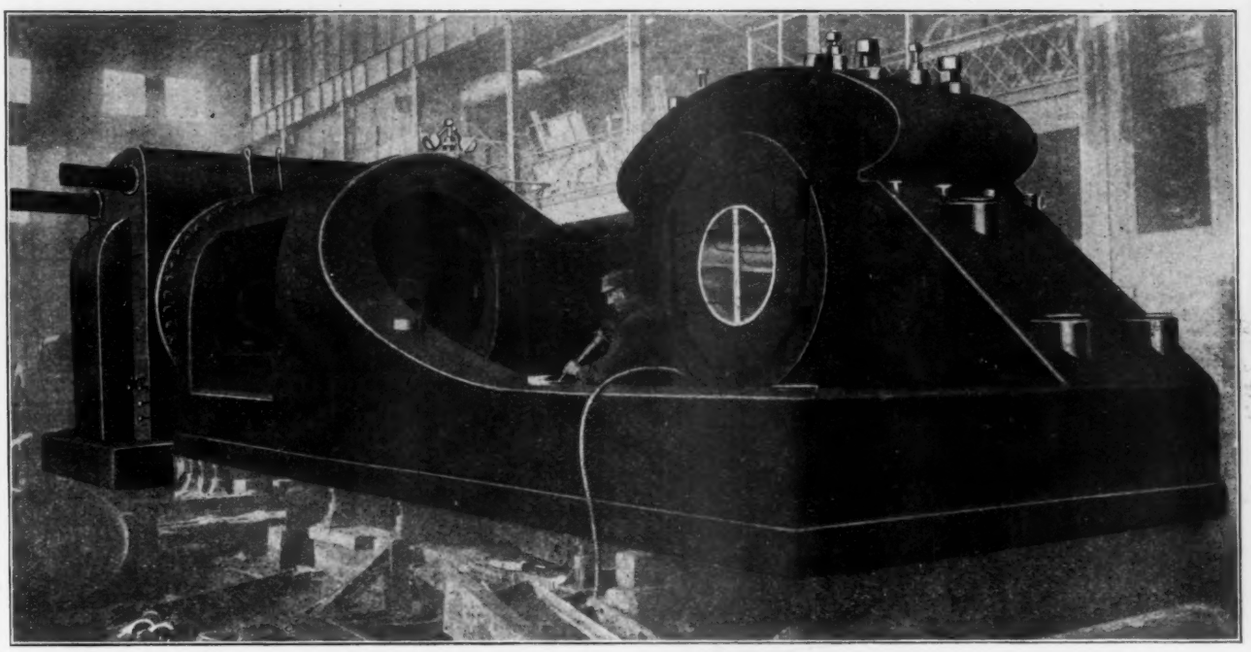

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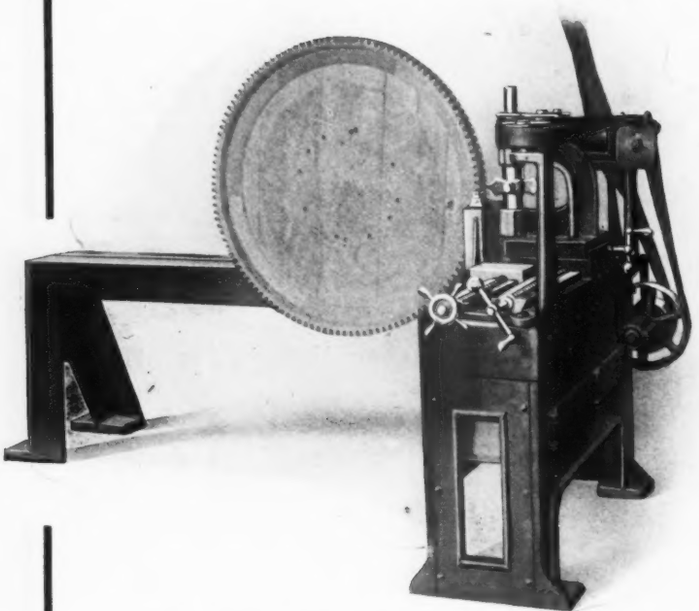

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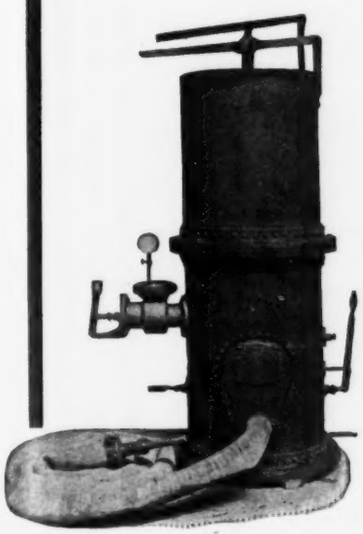

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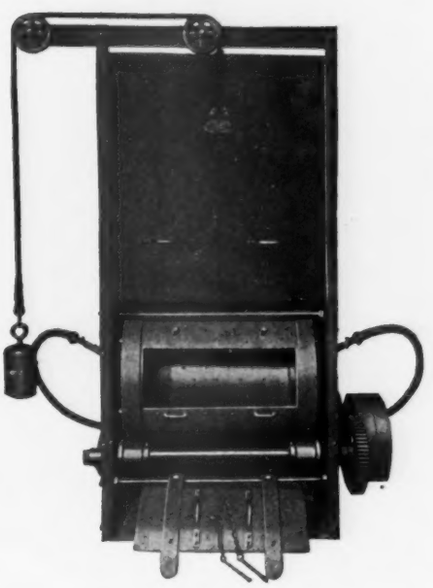

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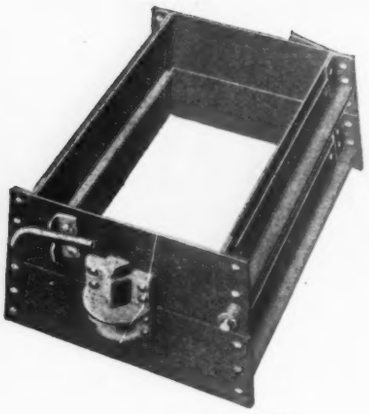

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Notice the tapered construction. The center illustration shows the Sand Supports on bottom of cope.

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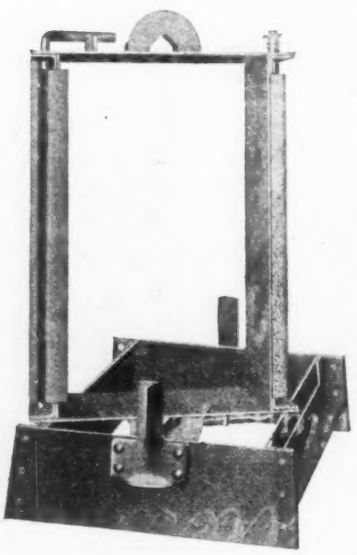

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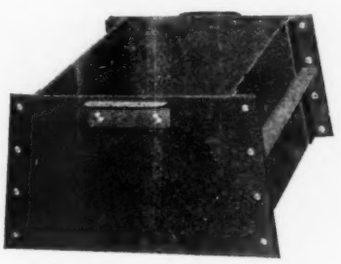

The Jacket locks the parting line tightly, absolutely preventing run outs.

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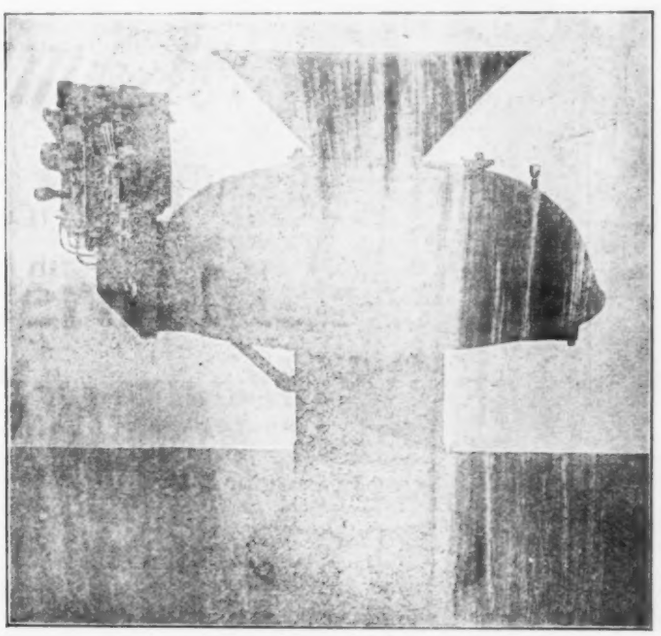

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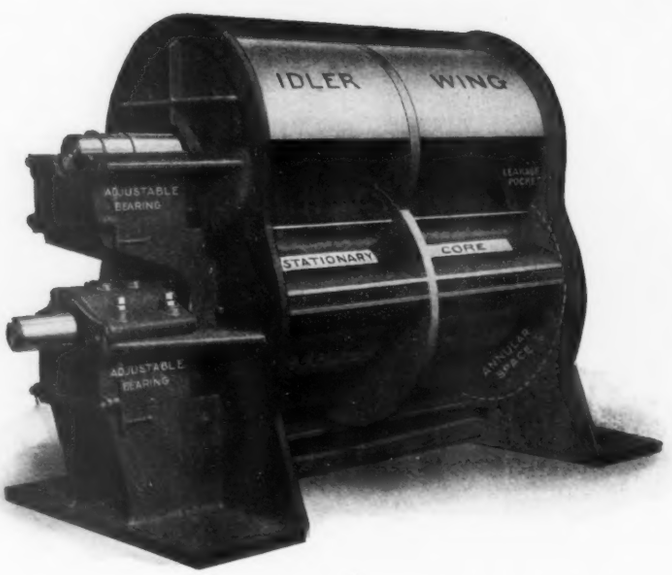

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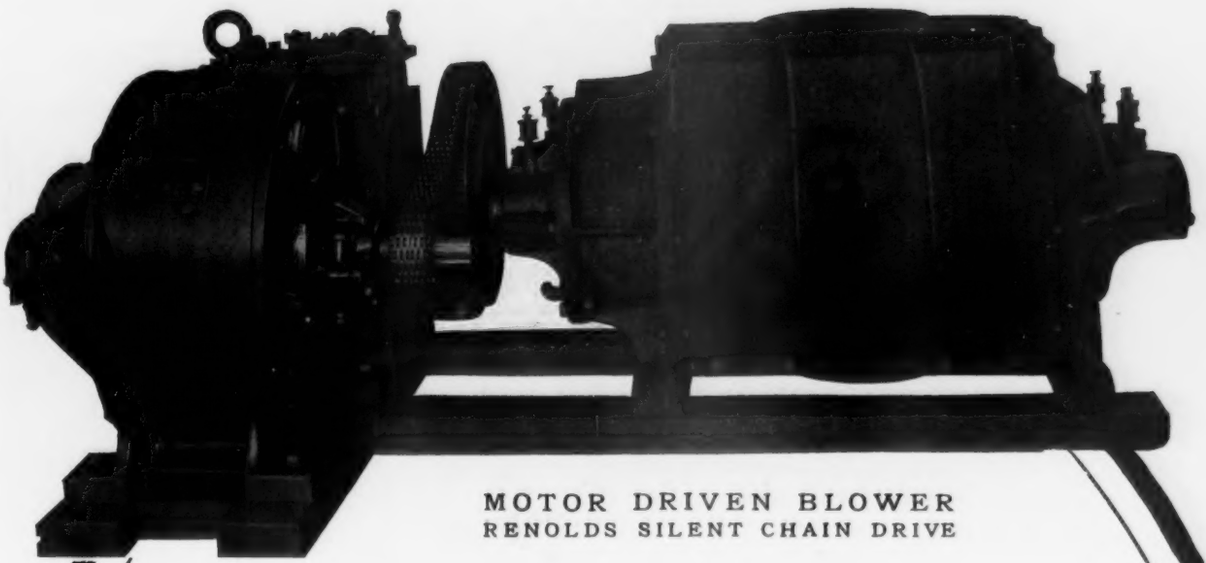

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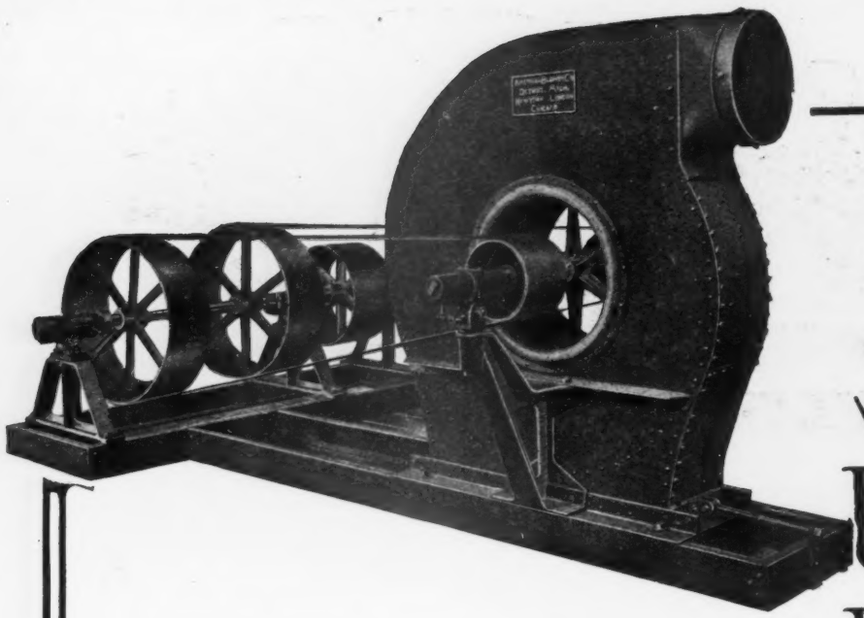

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(Signed) Lobdell Car Wheel Co.

By Wm. W. Lobdell, Pres.

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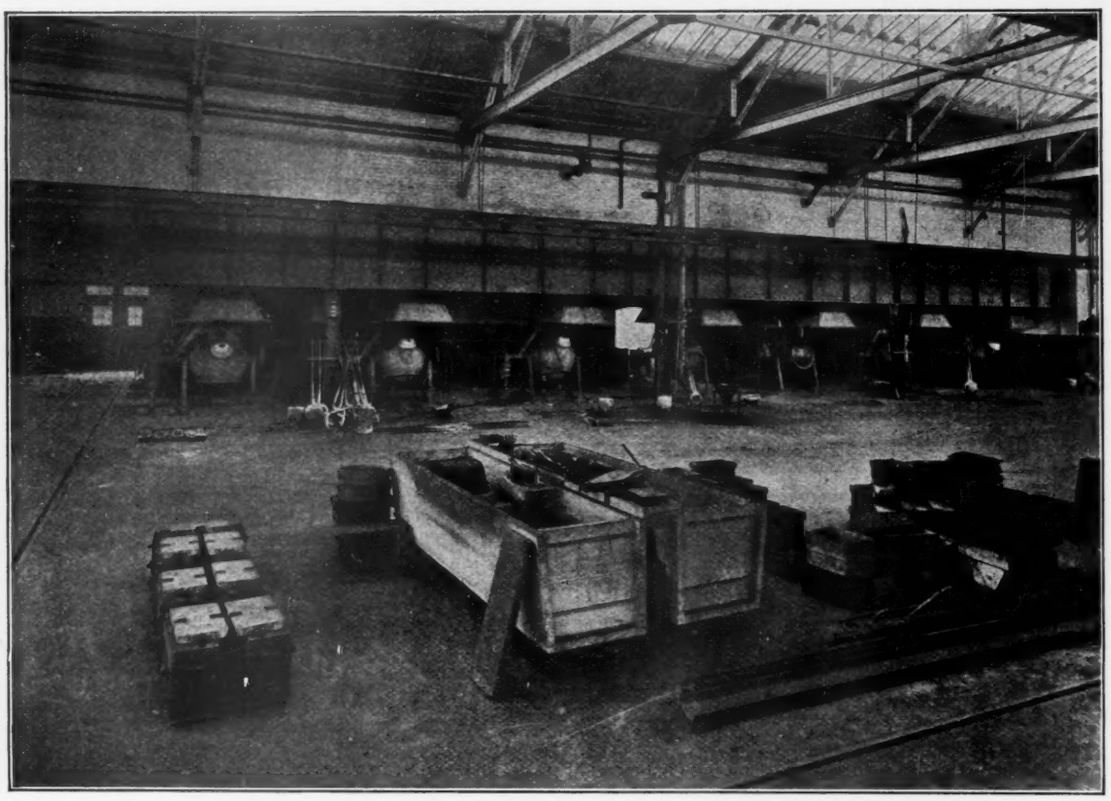

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"Stopped, short,
Never to go again
When the old man died."

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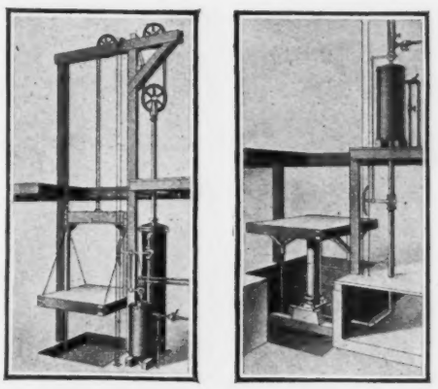
Cheer up, sonny!



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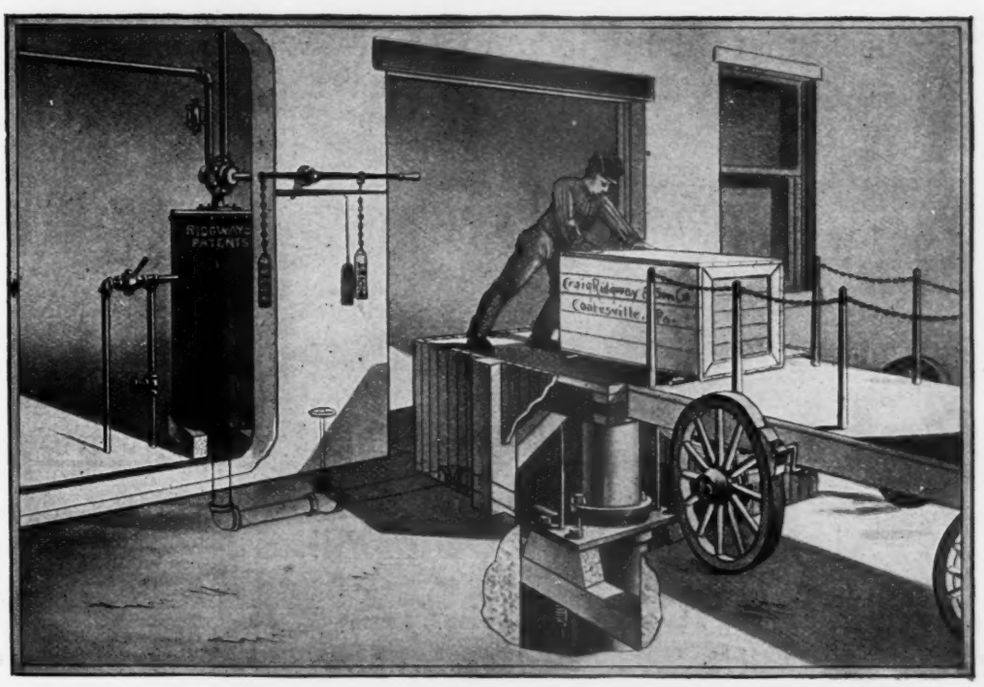

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THE FOUNDRY

Vol. 32, No. 2 CLEVELAND, OHIO, APRIL, 1908 Whole No. 188

MOLDING A LARGE ENGINE FRAME

Method of Making a 20-ton Casting in a Western Foundry—Use of Cope Plates

BY PAUL R. RAMP

THERE are very few foundrymen who have not had more or less experience in the molding of large engine frames, and they are, therefore, familiar with many of the little kinks in this line of work that have proven of value to them in producing these castings. Realizing this, I do not intend to pronounce the following method of molding and casting a 20-ton engine frame as superior to all others, but believe that the method to be described contains many points of interest to all foundrymen engaged in heavy work.

Engine Bed Mold.

The mold is made in dry sand, as it is too large to permit of the handling of the flask in the usual way. A large iron flask is built in a pit and the pattern is bedded in the sand. As the mold is thoroughly dried with charcoal baskets a large number of bricks are used which reduce the amount of sand that must be dried. At many points the sand wall between the bricks and the pattern is not more than 2 inches thick. The bricks also aid in carrying off the vents, and prevent any cuts on the surface of the mold. Large binders are used across the bottom of the flask which are securely bolted to the top binders after the cope plates have been placed in position.

Fig. 1 shows the mold finished and dried with the following cores in place: Guide core B, lighting core C, governor shaft core D, and the main bearing core A, which is ready to be lowered in position. The lighting core C is held in place by cast iron anchors. The governor shaft core D is fitted into a print in the wall of the mold and into a print in the lower half of the guide core, and is firmly held in position in this way. The guide core is made in halves and is placed in the mold separately, one end being held down by a print in the mold underneath the point indicated by E. Two large iron bars are placed over the top of this print and are rammed up against it, and extend back to the flask, through the sand and brick work. This greatly strengthens this print and aids it in resisting the lifting pressure on the guide core when the mold is being poured. The other end of the guide core is held down by two large cores that form that part of the mold. The guide core is furthermore held down by several cast iron anchors placed between this core and the lighting cores, that are placed above it.

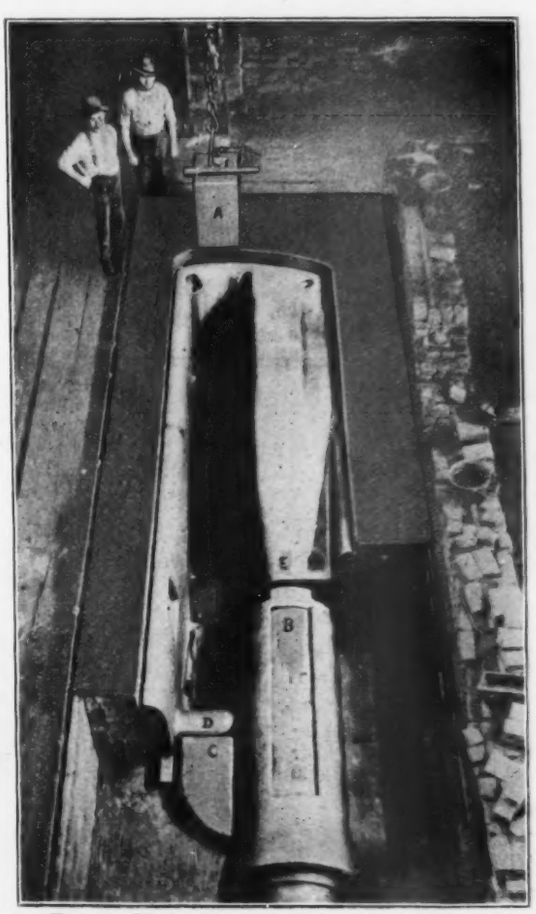


FIG. 1—VIEW OF THE FINISHED MOLD WITH SEVERAL OF THE CORES IN PLACE

Mold With Some of the Cores in Position.

A view of the mold is shown in Fig. 2 with all but the lighting core in position. This core is placed over the guide on the cylinder end. Great care should be exercised in placing the cores to

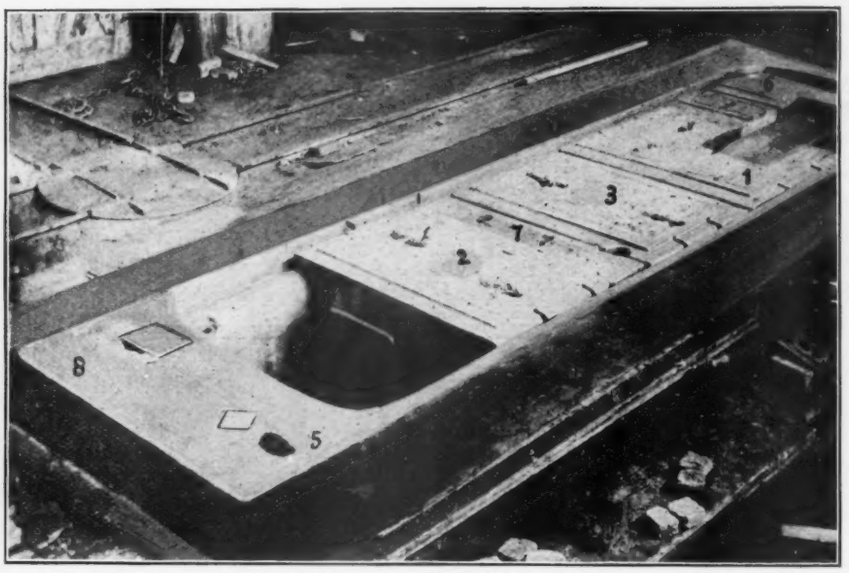


FIG. 2—MOLD WITHOUT LIGHTING CORES IN POSITION

insure the proper metal thickness at all points. To prevent cracks caused by internal strains, it has been found practicable to make the ribs somewhat lighter than the outside walls of the mold or frame. These lighting cores are all supported by cast iron anchors, and are held down by cope plates. The space between the two outside cores, 5 and 8, and the inside of the flask, is rammed up with molding sand, after which the last lighting core is set, and the mold is made ready for the cope plates. The lighting cores used in this mold are shown in Fig. 3. Core 5 is one of the outside cores used on the cylinder end of the mold. Special cast iron arbors are provided for cores 2, 3 and 5. These arbors have been found necessary to hold the cores in shape, and to insure a uniform thickness in the mold.

A lighting core that is located over the head end of the guide, is shown in Fig. 6. This core should be very carefully constructed, well vented and rodded, and as its lower portion cannot be seen when in position, the molder should exercise great care in locating it, as there is danger, if improperly placed, of cutting off the metal at this point of the casting.

Cope Plates.

One of the cope plates of the mold is shown in Fig 7. The cope consists of four loam plates provided with the usual number of prickers to hold the loam in place. By the use of these plates a large amount of the work required in ramming up the cope is obviated. Plate 1 is raised on edge to show the surface where the iron came in contact with it, and burned the loam. These burnt spots are scratched off and a few handfuls of loam daubed on, struck off and dried. This can be done in a very short time and saves the labor of sweeping up another plate. Aside from saving 90 per cent of the labor required in ramming up a large cope, the cost of the sand is greatly reduced.

The Casting.

A view of the lower side of the rough casting is given in Fig. 4, and shows the opening formed by the lighting cores. Another view of the rough casting is shown in Fig. 5. These frames are poured at both ends, the hottest iron always being poured into the guide end to insure a perfect casting at that point. A good grade of metal should always be used, and, in making castings of this kind great care should be exercised in securing the proper metal thickness at all points.

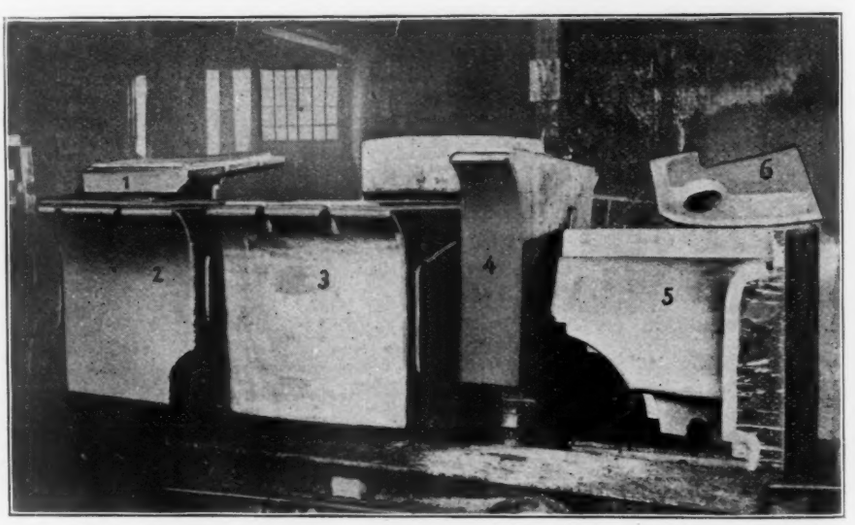


FIG. 3—GROUP OF LIGHTING CORES USED IN THE MOLD

STEAM.

BY H. SAYERS

The heading of this article seems out of place in a journal devoted to the interests of the foundry trade. This article, however, is not a treatise on the economy (or otherwise) of superheated steam, but treats of steam in the mold where, like dirt, it is distinctly matter in the wrong place and often thrusts itself into notice in the most forceful manner.

I have in mind the casting of three slag bowls or troughs, running about 3 inches thick and weighing about 600 pounds. They were wanted badly and, as often happens, that is the way they were got, for they blew up one after another as they were cast. The explosions were so violent as to shift the weights and lift the cope several inches. This trouble was caused by steam, as will be shown later.

Other effects of steam are scabs, both ordinary and of the variety known as dumb scabs. Also drawdowns, blow holes, dirty castings, etc. This is certainly a sufficiently formidable indictment, but we believe that there is ample proof in the case. That scabs are largely caused by steam and moisture is practically self-evident from the fact that they are rarely seen in a dry sand mold. However, as a rule, the sand used for dry sand work is much closer and contains more clay than that used for green sand work, and hence, is more liable to scab. The only element that has been removed from the sand in dry sand work is the water, which, if left in the mold, would be largely turned

into steam during the process of casting.

In many shops it is the practice when preparing the bed for a casting to make the sand under the mold as wet as the rest of the mold, and in some cases it is wetter. The hole is dug out to the proper depth and a bucket or two of water thrown in. The sand is then rammed up to the face of the mold and this is frequently dampened.

The result is, that when the metal fills the mold it falls into the lower part first and much of the moisture is converted into steam and driven higher into the mold where the cool sand condenses it. As the metal rises this moisture is again turned into steam and causes boiling and scabbing on the sides or top of the mold. At other times the metal rises above the place where the moisture has been condensed in the sand, and then the expansion of the steam forces a portion of the mold into a casting forming the worst possible form of scab, which is known as a dumb scab.

The sand in the lower portion of the mold should only be damp enough to enable it to hold the shape of the vent holes; in fact, the dryer it is the better. Above this point the proportion of water in each succeeding layer can be slightly increased. The facing for the entire mold, of course, must be made of sand tempered to the ordinary consistency, that is containing the ordinary percentage of moisture. Any extra moisture in the upper portion of the mold will be larely dried out during the process of finishing. When this process is followed, less venting will be required than when the mold is rammed up with moist sand throughout.

Concerning the origin of drawdowns, so called, many different opinions exist among molders. Some with whom I have worked would not have a vent wire put into the top part of a mold, maintaining that it left the pressure out of the mold and thus let the face drop down. Others pin their faith to holding the cover on the riser until the last moment before the mold is full, claiming that a rush of air through an uncovered riser in some mysterious way produces a suction in the mold and draws down the top; hence the name, which is a misnomer. These persons overlook the fact that the rush of air is evidence of pressure in the mold caused not only by the air being displaced by the entering metal, but also by the expansion of the air as it comes in contact with hot iron. Others find fault with the sand supplied and demand a tough sand containing clay as a remedy.

It is probably true that in the case of heavy green sand work where the mold is poured with a closed riser that the tough clayey sand is the best remedy.

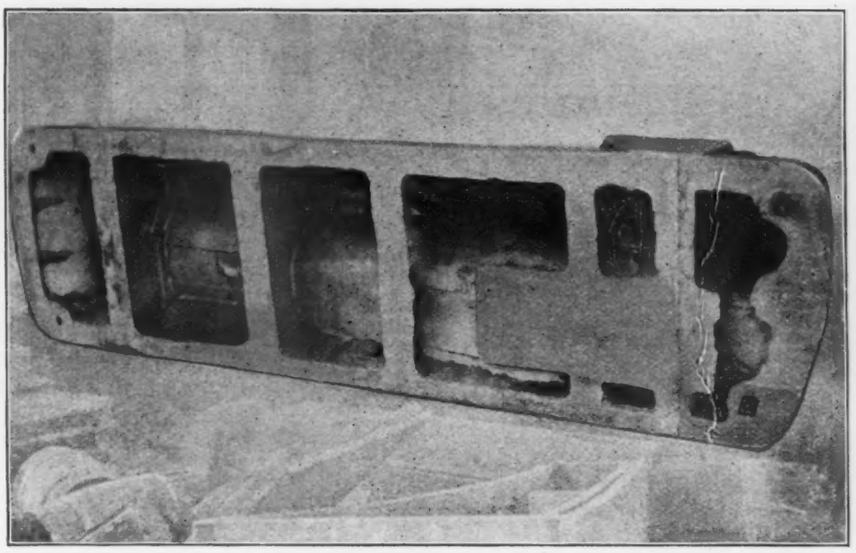


FIG. 4—LOWER SIDE OF THE ROUGH CASTING

I have seen it suggested by some that leaving the risers open will blow dust, etc., from the mold. There cannot be any blowing action of this kind in the mold any more than there can be in a boiler when the safety valve is blowing off. This is simply a steady pressure and the open riser acts as a safety valve to relieve this pressure.

However, in green sand work we do not want to relieve the pressure. This pressure may reach more than one pound per square inch, and the fact that the face of the cope will sometimes come down in spite of this pressure seems to contradict the idea of a drop-down and shows that there must be some force acting in the cope itself with a still greater pressure, which forces off the face. So far as I am aware there are only two factors present which can be guilty of this. They are the air and the moisture, and the fact that a good skin drying is a preventive of drawdowns, even in the case of green sand molds, seems to put the air theory out of court and leave us only the moisture as the guilty party as in skin drying the moisture is driven out of the surface of the mold.

In a green sand mold, when the moisture beneath the surface is turned into steam it generates considerable pressure. At first the steam probably tries to escape upwards and is condensed in the first layer of sand above, but the heat follows more rapidly than the moisture can escape, so that finally there is a large volume of steam which is constantly increasing as the heat penetrates deeper into the molds. This will naturally take the path of least resistance and force off the face of the mold.

The slag bowls, previously mentioned, were made bottom down, the

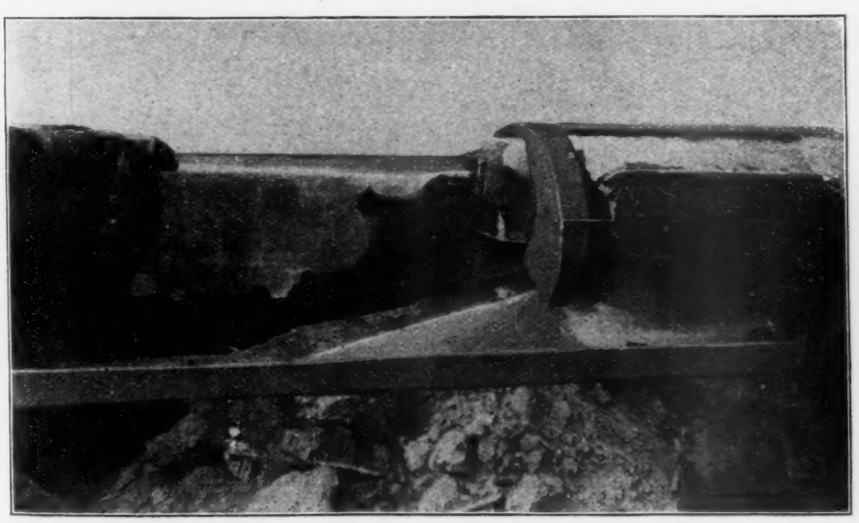


FIG. 5—VIEW OF THE ROUGH CASTING

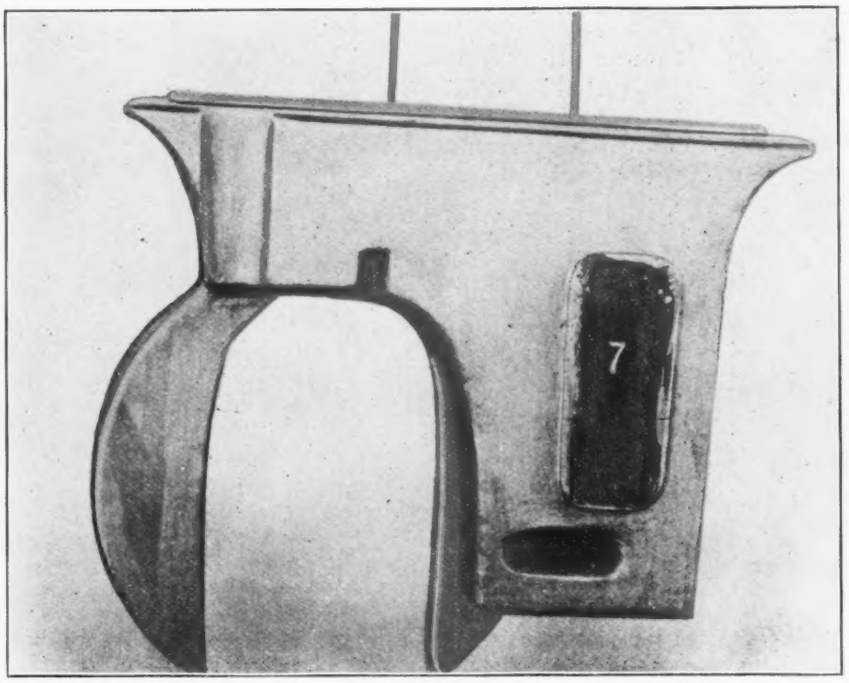


FIG. 6—ONE OF THE LARGE LIGHTING CORES

molder using a strong and rather wet facing sand for ramming up the inside. The inside was lifted off with the cope and in previous cases had always been skin dried, but the molder decided to omit the skin drying in this case, thinking that the heat of the rising metal would probably dry it sufficiently. His theory might have worked out all right if the cope had been filled with vents to permit the escape of the steam during the drying, but the vents were conspicuous by their absence, and the rising metal generated steam at a constantly increasing pressure until the limit of the mold's resistance was reached and the whole cope blew up as already stated.

A good preventive for accidents of this kind is found in the free use of vent wire so as to give a ready escape to the steam and hot air during the casting. Another plan is to ram over the facing sand, first over the ends of the gaggers, bars, etc., and then to riddle on an inch or two of dry sand thereby lessening the amount of moisture and providing some dry sand to soak up the steam driven out from the face during pouring. A third method, and probably the best one, is to use sand which will stand drying and then skin dry it. In this case it is best to cover the gaggers with the facing sand to a depth of an inch or so, as this permits of the drying of a mass containing the ends of the gaggers. This process will hold the skin dried surface firmly against the rest of the mold. If the skin dried surface is only held to the rest of the mold by the adhesion of the sand or the clay wash on the gaggers, the expansion of any steam present in the next layer of sand may force off the dry skin.

In all cases the vent wire should be used freely over any heavy chunks. Loam plates for covering green sand jobs must have plenty of holes in them to provide passages for the steam to escape up to the green sand as the metal rises.

Blow holes are often caused by steam condensing on studs or chaplets in the mold and causing them to rust. Moisture is also frequently absorbed by cores, and subsequently causes blowing about the cores. If a large core be placed in a green sand mold while the core is very hot the chances are that the mold will be badly scabbed, caused by steam generated by the hot core. The same effect is sometimes seen when a skin-dried top is put on a mold while the top is still hot.

Dirty castings are very frequently caused by the boiling of the metal in the mold due to the escape of steam from the lower portion of the mold up through the metal. The agitation of the metal detaches the sand from the face and at times washes enough of it into the casting to cause a waster.

I expect that the readers will be tired of the subject by this time, and I will close with the warning "Beware of the Steam."

MANGANESE RESISTANCE METAL.

This alloy is used as a substitute for German silver, especially for resistance boxes for electric measurements. Its specific electric resistance is only 0.03 to 0.045 that of copper. It consists of copper, 85; iron, 3 and manganese, 12.

FIG. 7—APPEARANCE OF ONE OF THE CORE PLATES AFTER THE MOLD HAD BEEN POURED

MOLDING A CAST STEEL CLAM-SHELL

A Noteworthy Example of Skeleton Pattern Work—Method of Molding

BY H. J. McCASLIN

HERETOFORE clam-shell buckets have been a product of the smith shop, forging the arms and shaping the bucket by hammering and drawing a plate over a cast iron former having been the method employed. The riveting of the arms to the bucket is identical to the method under discussion. Embodied in the work are features of modern pattern shop and steel foundry practice that demonstrate the possibilities of steel castings and their adaptability to other awkward forms and shapes.

A 4-cubic yard clam-shell of cast steel construction is illustrated in Fig. 1, being one of a number of various size buckets made by the Wellman-Seaver-Morgan Co., Cleveland. While the total number of castings required in each bucket is 16, we will only consider the noteworthy sections—the arms and bucket shells.

Shown in heavy lines in Fig. 1, is the bucket in its closed position, the fine lines showing its outline when open or extended.

The Castings.

Fig. 2 shows two views, one of the inside and one of the outside arms, a right and left hand of these two parts being required. At the right is shown the right hand inside arm, while at the left is the right hand outside arm. This may appear somewhat clearer by studying Fig. 1, as it will be readily seen that two of the arms are attached to the inside of one of the buckets, and the other two arms to the outside of the opposite bucket. Three views of one of the buckets is shown in Fig. 3. This had a metal thickness of about one inch.

The Bucket Pattern.

As a portion of the arm patterns are usually fitted to the bucket pattern, the latter would naturally receive first attention. Owing to the form and thickness of the bucket it is needless to state that making a complete pattern would be anything but practical, unless a number of duplicate buckets was to be made. If such were the case, then a cast iron pattern, made from a skeleton pattern, as discussed, would be the only solution.

Skeleton Patterns.

Skeleton patterns, while usually of an inexpensive construction, considering the work they are intended to perform, have their advantages and disadvantages, being usually resorted to in producing hollow or shell castings of such form that will permit the core forming their interior, to be rammed up in place and subsequently lifted out.

As the name implies, this form of pattern is not complete in itself, but ribbed or skeletoned so as to form the interior and exterior alignments of the object to be cast. The ribs provide surfaces upon which strikes are used by the molder in striking out the sand thickness between the ribs completing its contour.

A full size plan elevation and cross section at the center of thebucket are essential, as they are required in getting out the parts shown in Fig. 4. Except the general outline of the bucket, the degree of accuracy required is of little importance, a feature favorable to the patternmaker. Should the requirements be such that the bucket surface must be true to the given form, the amount of labor involved would greatly exceed that required in this case, as it would then require the development of several full size sections. The three parts A, B, C, shown in Fig. 4, are made first and secured together as shown in Fig. 5, which illustrates three views of the completed skeleton. Care should be exercised in getting out part B, owing to the form of the bucket, or the manner in which it drops back at D, Fig. 5. This section cannot be taken directly from the layout. In getting out this particular part it may be built up in three courses of ⅞-inch segments of

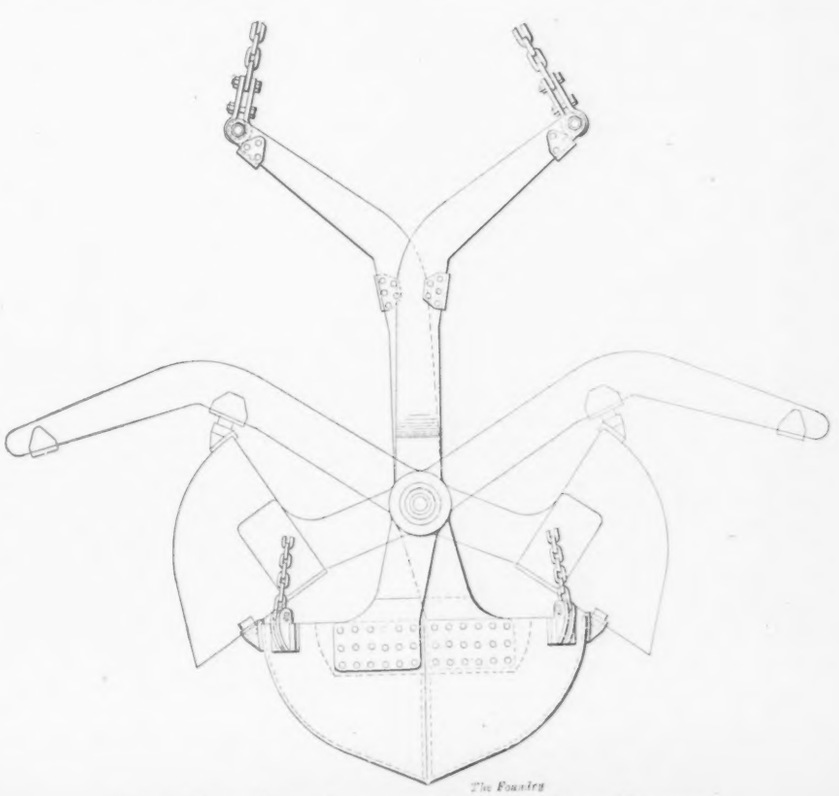


FIG. 1—CLAM-SHELL BUCKET IN OPEN AND CLOSED POSITION

ample width to permit of sawing it nearly to form.

Fig. 4 shows one way that it can be approximately layed out. Radius E, which is the given radius for this outline of the bucket, is first scribed. Referring to the layout of the cross section, the amount of drop, as shown at I, Fig. 5, which would take place in the height of the segments is noted and layed off at F. With a radius G, equivalent to E, less the amount of drop, and with the center changed as shown at H these two arcs of circles are scribed. Shifting the centers as shown at H is largely a matter of judgment. It will be found advisable to shift when a trifle too far than not enough, as a little surplus material is easily removed. With the outside of part B only sawed and dressed to form, the three parts A, B and C are secured together as shown in Fig. 5.

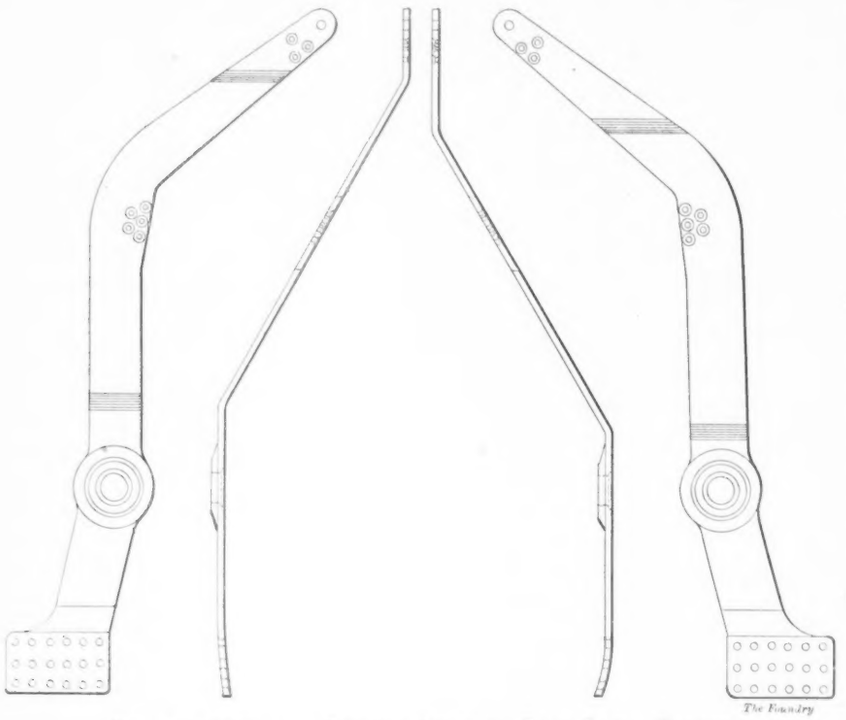


FIG. 2—INSIDE AND OUTSIDE ARMS OF CLAM-SHELL BUCKET

The Ribs.

As the bucket is symmetrical at its center line, all vertical ribs are made right and left. This would mean the fitting in place and dressing to form the ribs for one side, which are subsequently used as templets in marking off the opposite hand.

Shown at I, Fig. 4, is one of the diagonal ribs. Owing to their position they are the most troublesome parts to make. As previously stated, this section could be developed, but a shorter way out of the dilemma, and one close enough for all practical purposes, is to saw out a part model of the bucket to a scale of 1½ inches to 1 foot. Then saw the model in two on the line of the section desired, and lay down a full size section by scaling the model. With the outer form of the two ribs sawed out, they are returned and temporarily secured in place, and getting out the remaining vertical ribs, and securing them in place in a like manner receives attention. This is a comparatively simple matter, as the stations now in place will give all the lines or joints necessary for their development. With a flexible strip and a fairly good eye the ribs are gone over and dressed, that the various stations will conform to each other. As the inner sides of the ribs are in the rough, they are dressed to form according to the metal thickness and when returned to the position which they occupy, their intersection with part B is noted. Should there be any difference, part B is dressed off to conform with the ribs and all parts securely screwed together.

With the fitting in of the cross bracing and reinforcing the metal at J, as shown in Fig. 3, the skeleton pattern is completed.

Bucket Arm Patterns.

Referring to Fig. 2, the form of the bucket arms as shown should be noted. As previously stated, a right and left hand of each arm is required. The pattern work for the outside and inside arm being practically the same, a discussion of the pattern work for the latter will be sufficient. Owing to their awkward form, it will be readily seen that it is out of the question to make a pattern at the minimum cost without some kind of a mounting that it will retain its proper form during the molding operation. For this reason, the pattern, consisting of six parts, as shown in Fig. 6, was mounted on the frame K as shown in Fig. 7. This arrangement was found not only practical but very economical, as it permitted the frame as well as parts L, M, N, O, to be used for both right and left patterns. Parts P and Q are of such form that they are reversible.

Making the Frame.

As in all pattern work of this nature,

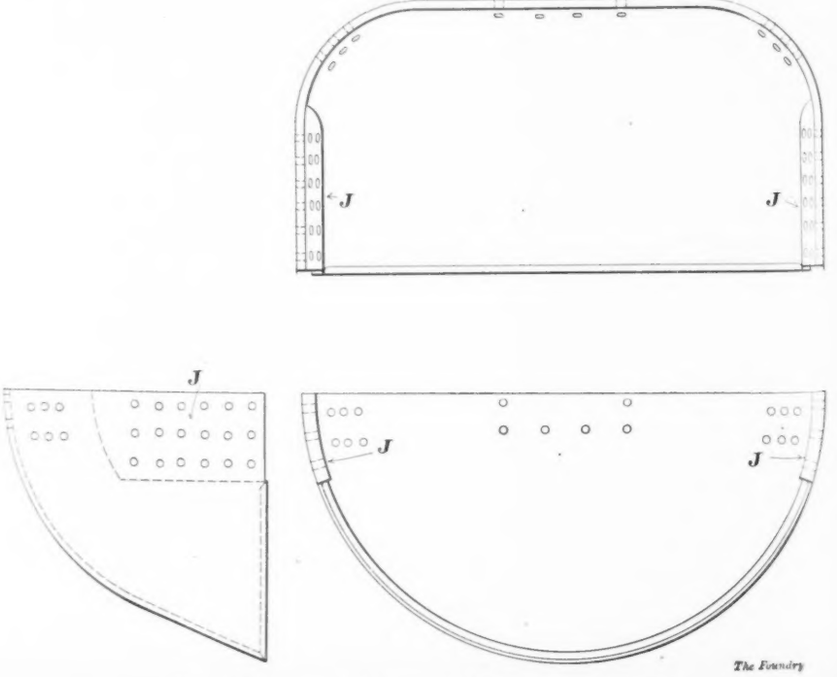


FIG. 3—SECTIONAL VIEWS OF ONE OF THE BUCKETS

a full size plan and side elevation layout is required. Fig. 7 shows three views and a cross section of the completed pattern as it would appear mounted upon its frame. The upper edge of the frame coinciding with the outline of the side elevation of the arm, is made about 1⅜ x 4½ inches and is securely cleated together as shown. As the sides of the frame are used as the center line during the assembling of the pattern, they must be free from wind.

Upon the plan layout previously made the frame is then secured and braced in its proper position. Extension R and bucket S, with their necessary bracing, having been prepared, are secured to the frame at their respective stations.

Mounting the Pattern.

As parts L O, Fig. 6, lie in the same plane as that of the layout, they can be made to dimension and secured to the frame in their correct position. This,

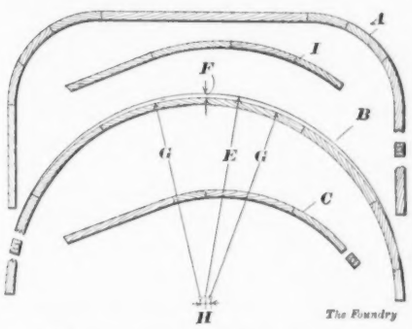


FIG. 4—PARTS OF THE BUCKET PATTERN

however, is not the case, as parts N and Q, not lying in the same plane as that of the layout, their form can not be taken from it. For this reason, material of ample width and the required length is prepared for these two parts and secured to the frame directly over their location thereon. It then becomes a simple operation to project their outline upward from the layout, and to transfer it to the material in this manner, which is then removed and sawed and dressed to form.

In attaching the various parts of the pattern to the frame, the screws must be inserted from the under side. This arrangement permits their withdrawal at the completion of the bedding-in of the pattern. For this purpose blocks T are attached to the frame and the screws inserted through the blocks as shown. Attention is directed to the part P of the pattern as shown in Figs. 6 and 7.

Molding the Arm Pattern.

As there are no particular features of interest involved in the molding of the arm pattern, a brief outline of this work will only be given. As in the case of the bucket pattern, the arm pattern is molded in the floor. Not only is it a troublesome piece to bed-in, owing to its irregular form, but it requires a comparatively large flask for a casting of its weight.

Fig. 9 shows a longitudinal and two cross sections of the mold at several stages of completion. At the right is shown the work at an early stage. The dotted lines show the position of the frame before its removal from the pattern, as well as the position the cope flask would occupy and this would necessarily determine the parting lines.

The initial work on the mold consists of the bedding-in of the pattern in about the position shown, and the removal of

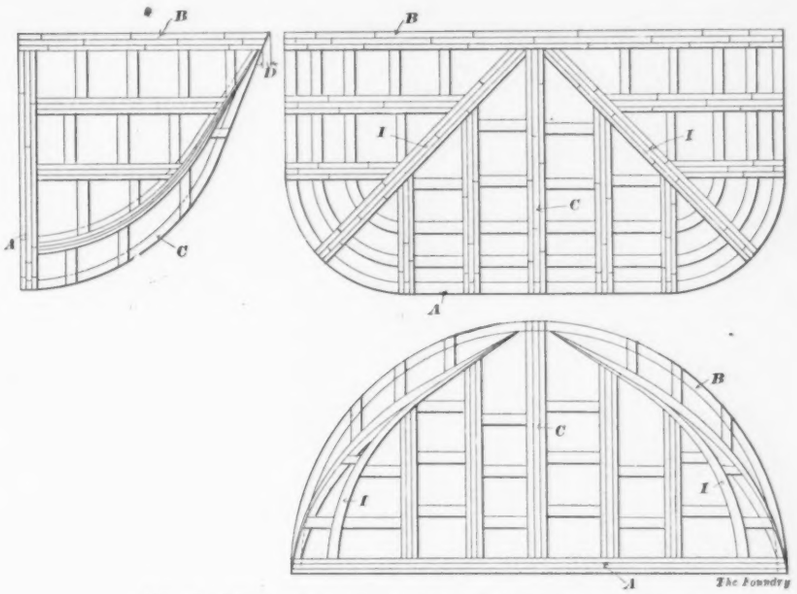


FIG. 5—VIEWS OF THE COMPLETED SKELETON PATTERN

the frame as previously stated. The parting is shown in the lower cross section.

Arrangement of Gate and Riser.

A diagrammatical sketch of the arrangement of the gate and flow-off is shown at the upper right hand side of Fig. 9 and is self-explanatory. As this portion of the arm is vented to the bucket casting, a good bearing surface between these two parts is essential. To ensure that they conform to each other, this portion of the arm pattern is built or lagged up of strips over that surface of the bucket pattern which the arm is to occupy.

A better way, if time will permit, is to lag up this portion of the arm pattern over the bucket casting itself, which will further ensure the matching of these surfaces.

This work at its completion is shown in two views, Fig. 8.

In changing the frame for the opposite hand, all parts are used, being simply reversed and attached to the opposite side of the frame as shown in dotted lines, Fig. 7.

With one pattern completed and the parts made for the change, the work is up to the molder.

Molding the Bucket.

Digging a hole in the foundry floor of ample size to receive the skeleton pattern constitutes the preliminary work re-

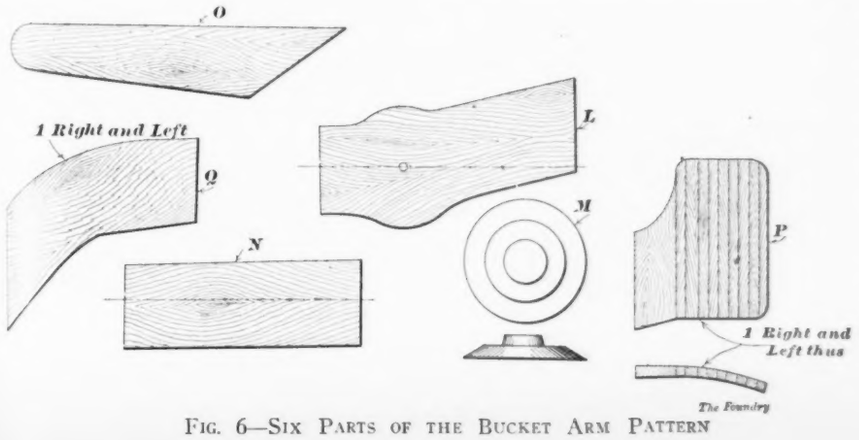


FIG. 6—SIX PARTS OF THE BUCKET ARM PATTERN

quired for a mold of this form. Setting and temporarily bracing the pattern in the desired position is the next operation, which is followed by firmly backing in its exterior form with sand. Heap sand is used until within about ¾ of an inch of the pattern, the mold being faced with silica or a silica sand mixture. Sand is then rammed in between the ribbing of the pattern and struck off to conform to its interior outline. Striking off and arranging the parting follow in order, a cross section of the mold at this stage of completion being shown in Fig. 10.

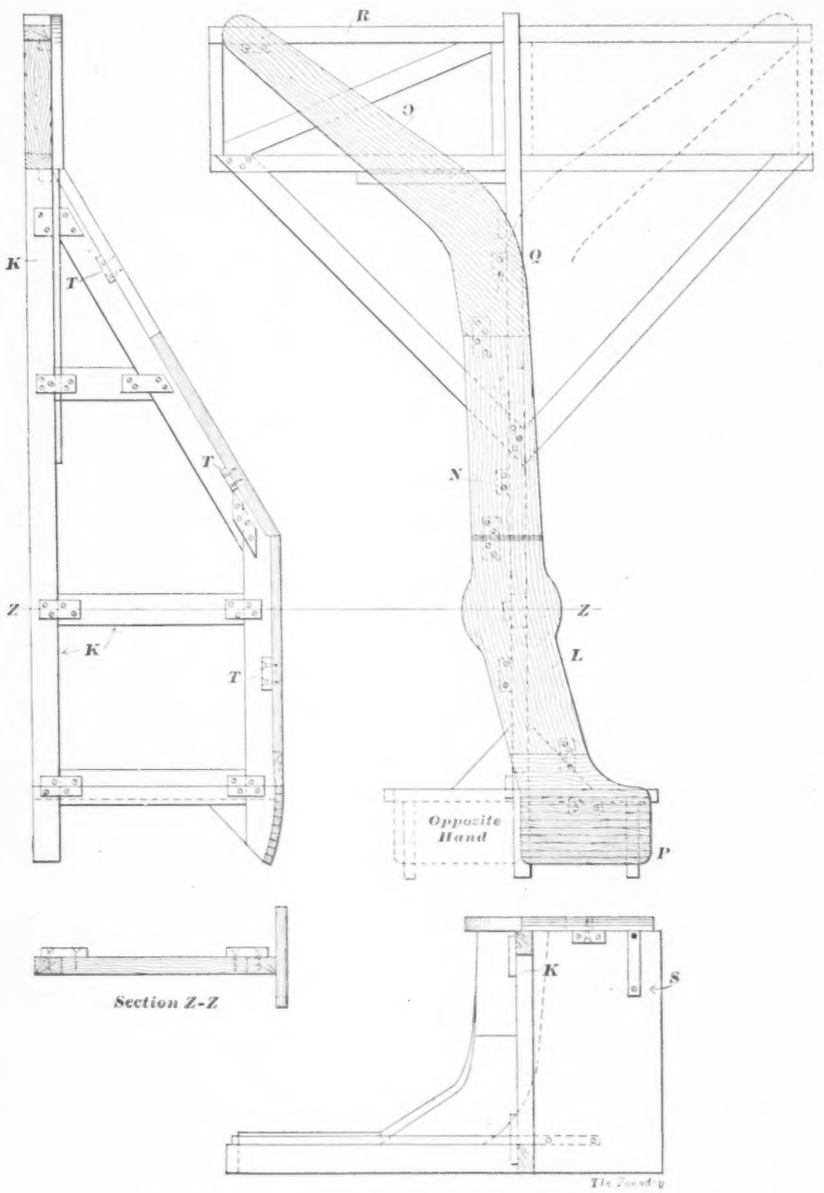


FIG. 7—BUCKET ARM PATTERN MOUNTED ON ITS FRAME

Gating the Mold.

Shown in smaller detail in Fig. 10 is the form of gating used, being cut down about two inches below the parting line covered with a plate U as shown in Fig. 11. Gating the mold in this way provided for a 2 x 1-inch section of metal above the gate which cooled first and prevented shrinkage cracks appearing at these points. Two small risers, or what may be more properly termed flow-offs, were placed upon the edges as shown at V.

Paper as a parting material was then applied over the entire surface of the mold and its partings. In order that the core or that body of sand forming the upper surface of the mold could be lifted out, a lifting iron or grate was introduced and blocked up near the bottom as shown at W, Fig. 11, which is a cross section of the completed mold.

Ramming Up the Core.

Silica facing was next applied over a portion of the bottom and the ramming up of the core was the next operation. Gaggers were freely used in connection with the lifting grate to secure the body of sand below it, while above the grating the overhanging portion of the core was secured and supported by ample cross rodding.

The operation of applying the facing, and the ramming and rodding were repeated until the top of the pattern was reached. Preparations for placing on the cope were then made. As the cope and core are lifted off together, these two parts were received by bolts X extending up from the grating.

With the placing on and staking down of the cope and the arrangement of the runner and flow-offs, the ramming is resumed until the cope is completed.

Channels supporting short sections of rails, as shown in Fig. 11, are placed across the cope and the two parts of the mold are securely bolted together and lifted off and blocked up.

Returning to the floor portion of the mold, the sand between the ribs is roughly removed and the pattern lifted out. Guided by the impression left by the outer form of the ribs, the intervening surfaces are carefully dressed and slicked off to coincide with same. Both parts of the mold are dried and all that remains to be done is to try on the cope for the metal thickness. If correct, the mold is prepared for the metal.

CORE OVENS FOR LIGHT AND HEAVY WORK.*

By B. F. Fuller

The core oven, while recognized as indispensable in the foundry, is frequently as much a source of annoyance as the oven of the cook stove or range in domestic use. Most of us have heard, no doubt, the "Fussy Talk" of the ladies of the kitchen over a roast or cake burned on top and underdone on the bottom, or vice versa; so it is with many core ovens. Attend to it as carefully as you may, it will, either under forced firing burn the surfaces of the cores, while the interiors are green, or will not dry them enough to make them fit for use in less than double the time necessary under proper conditions. Different styles of ovens are required by different shops according to the class of work turned out.

Ovens For Light Work.

A shop making nothing but light specialty work does not require the same kind of an oven as is necessary for heavier cores. The class of work, as well as the amount handled should decide the needs of a permanent installation. For a shop having approximately 40 men on bench, or light floor work, in my opinion

*Presented at the March meeting of the Pittsburg Foundrymen's Association.

some of the small and medium sized portable ovens which can be installed at a comparatively small cost are amply sufficient and very economical. For instance, a portable oven constructed of cast and sheet iron with hinged shelves which swing open with the door, and have following doors or dampers attached to close off the openings while the shelf is exposed, thus conserving the heat, is, when properly fitted up, a more efficient oven than many built at double the cost. In such an oven, a saving of fuel and increase in efficiency can be effected by enclosing the sides and back in a galvanized, or sheet metal casing allowing two or more inches between the oven and the casing to be packed with asbestos, scrap mica, mineral wool from the cupola slag spout or some other non-conducting material. The casing should also be made two or more inches higher than the ovens to allow for a couple of inches of the packing material to lie over the top. The fire boxes are usually too small as furnished, and give better results if increased in size by raising the walls three or more inches. Gas coke should be used in preference to cupola or furnace coke, as a quicker and hotter fire will result. This applies to the small and medium sized ovens with small fire boxes. As the shelves are frequently moved in and out a good hot fire is necessary, and with the small amount of fire space the slow burning coke will not give the heat required. When gas is used an excellent arrangement can be made with the ordinary burners used in the ovens of most of the cooking ranges of today. These can be easily regulated from the outside and two or more per oven can be used as required.

It is an easy matter to add other ovens to this equipment attaching all to one horizontal flue pipe, leading to one stack.

Where the number of medium sized cores to be made would call for a more permanent arrangement, the oven built of brick walls, iron frames, with tiers of draw shelves running in and out upon roller bearings with following doors, or dampers, to close off openings when shelves are exposed, is excellent when fire box and flues are properly arranged. With coke as the fuel, the fire box should be built at one end, and placed below the floor line and fired from an outside pit. Cupola or furnace coke is preferable here as the fire box is of sufficient size to hold a body of coke large enough to give forth an intense heat under proper draught.

The flues, two in number, extend from the fire box the entire length of the oven underneath the floor and open at the floor line against the wall furthest from the fire box. These flues are tile covered and heat the floor uniformly. The heat escaping from the flue openings is drawn back through the tiers of shelves to the openings into the stack at the same end of the oven as the fire box. These four openings ino the stack are at the floor and roof lines. The ovens contain eight tiers of shelves and have five or six shelves in each tier. The shelves, which are 3 feet wide and 6 feet long, of varying depths, give an oven approximately 25 feet long, 6½ feet wide and 7 feet high. What I wish to call attention to, is the size of fire box and flues that give the best results in an oven having the dimensions given. The fire box should be 4½ feet long, 3½ feet wide and

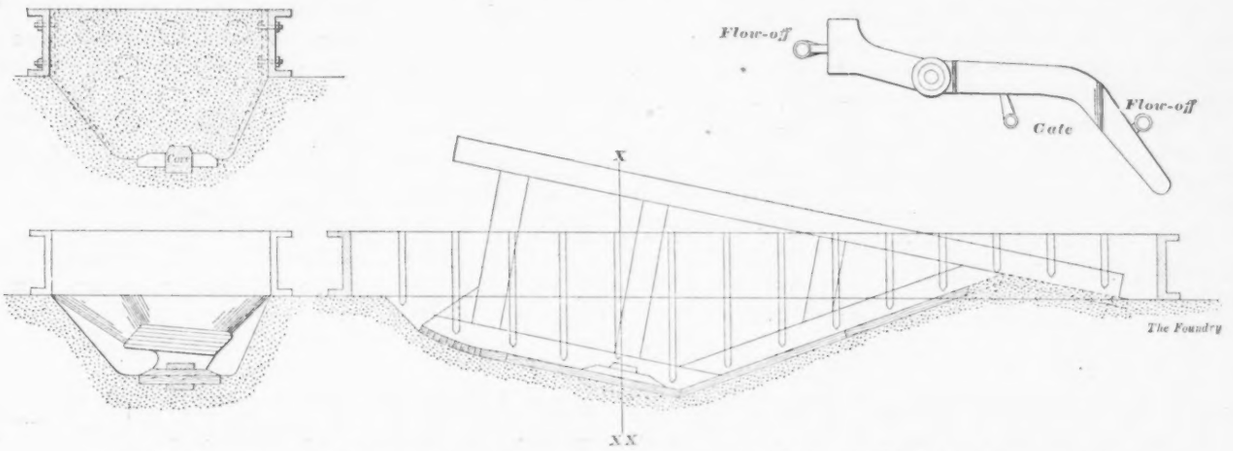


FIG. 9—SECTION OF THE MOLD FOR THE ARMS AND SKETCH OF THE GATE AND FLOW-OFF ARRANGEMENTS

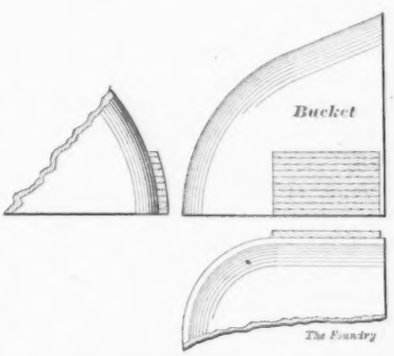


FIG. 8—METHOD OF LAGGING PORTION OF THE ARM PATTERN OVER THE BUCKET

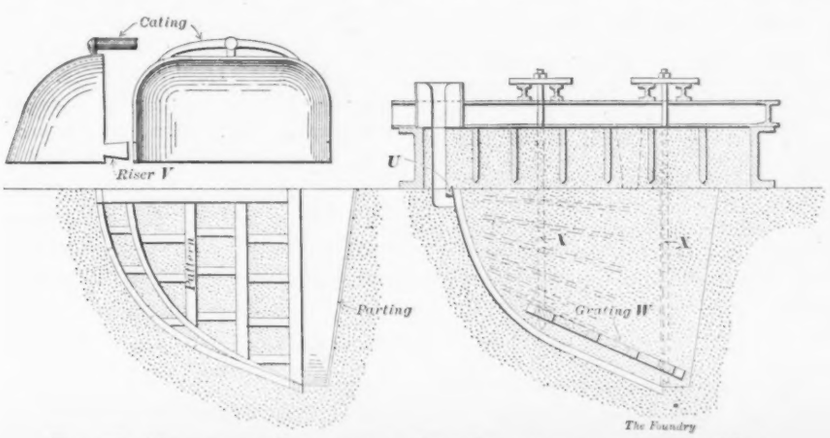


FIG. 10—METHOD OF GATING AND CROSSSECTION OF THE BUCKET MOLD

4 feet high, with flues leading under the floor, 22 inches deep and 30 inches wide. The openings into the stack should be large enough to take care of the gas and steam arising when firing up, and should be fitted with dampers which can be worked from the outside. Where gas is used, I prefer burners along the floor under the shelves with a protection provided to prevent scorching the cores nearest the burners. This does away with the fire box and flues. The coke fired oven, arranged as above, is more satisfactory. Where a large amount of heavy core work is done, ovens should be arranged accordingly.

Ovens for Large Cores.

At the foundry where I am employed, there are four ovens for large work, each 10 feet high, 13 feet wide and 24 feet deep with two standard gage tracks in each. Each track accommodates two trucks. or four large trucks per oven, 16 trucks in all.

These four ovens, with a fifth drawer-pull oven for quick drying are fired from one pit resembling the firing pit of a good sized boiler house, the fuel descending from above through chutes. One large flue extends the full length of the pit and connects all to a central stack for draught, which is excellent.

Across the front is a depressed track on which operates a transfer buggy which enables us to place any core truck in any core oven. Flues extend from the fire box under the floor into each opening in a line just inside the doors, one in the center between the two tracks, one under each track and one outside each track along the walls. The center flue is 18 x 22 inches, and those under the tracks are 25 x 22 inches. Those along the walls are 8 x 22 inches, giving a total flue area of 84 x 22 inches. These have always given good service, but lately their capacity has been increased by enlarging the flues and fire boxes to the dimensions just given. In doing this I found that not only was the capacity increased but fuel was saved, the life of the brick work lengthened, and the fireman does not work so hard.

PRODUCTION OF MALLEABLE CASTINGS—III

A Discussion of the Methods of Making Tests of Malleables—Improvement and Deterioration in Quality

BY RICHARD MOLDENKE

COMING now to the regulation test for malleable castings, we find it customary to provide for two classes, the heavy and the light. Thus the 1-inch square bar represents work ½ an inch thick and over, and an inch by ½ an inch section bar cares for the lighter castings. The bars are both 14 inches long. They should be cast at the beginning and at the end of each heat. About the fifth ladle from the start is generally selected for the first mold of test bars, and similarly the fifth ladle from the end, as nearly as may be gaged by the melter, serves for the last of the iron. Test bars and test wedges are cast from the same ladle, the molds being close to their respective furnaces. The idea is simply to have a record of all the metal cast from each furnace day by day.

Shape of the Test Bars.

The rectangular shape is used for test bars in preference to the round section, because the latter invariably shows serious shrinkage in the center, especially if the diameter is large. It is bad enough in the square bar, slightly so in the flat one, but in reality the sections thus used correspond to the casting's it is customary to make of this material. A round section, unless in very light hardware, is avoided by the experienced malleable man, as he never knows but what the shrinkage in the center might have an outlet to the skin, and cause failure in service. The arguments in behalf of a round test bar for gray iron do not hold for malleable cast iron, as we deal here with an absolutely white iron, crystallized through and through. The complete change brought about in the structure through the heat treatment in the anneal, wipes out every trace of hardness, casting strains, even crystallization; and hence the four hard corners and soft intermediate spots existing in the square gray iron bar are absent in the finished malleable casting.

Interior Shrinkage of Test Bar.

Now about the interior shrinkage of the test bar. If an inch square bar is pulled apart in the testing machine, there will be a slight elongation in one part, the break being at its center. This part, the elastic limit of which was exceeded, is very short, and hence it has become customary to take the elongation within 2 inches. Thus, the bar which is to be tested has pricked on one of its sides a series of center punch marks, each 2 inches apart, and when the break occurs, the elongation is measured between the nearest points in question.

Suppose the break occurred very close to one of the jaws of the testing machine. It is then possible to place the same bar minus its short end in the machine again, and get another pull. Occasionally a third test can be had from the same bar. This has actually been the case time and again during the investigations of the writer, and the results have run say, 51,000 pounds per square inch for the first test, over 54,000 for the second, and 59,000 for the third. In the case of a more uniform material, like steel, where there is a stretching of the whole of the test piece before breaking at one point, the piece, if tested again, is considerably stronger than it was, a fact well known and nefariously used in the armor plate scandals now long forgotten. In the case of malleable, however, the test bar is not stretched except at the one point, the elastic limit being fairly close to the ultimate, and hence the bar, except at the very break, is in just the condition it was before the test. The first time it breaks at the place where the interior shrinkage is largest, the second time, at the next smaller shrinkage place, the third time, at the place still smaller, and so on, if this could be repeated indefinitely. All of which shows that but for this

shrinkage problem some very great ultimate strengths could be obtained. As a matter of fact after the writer got to know something about malleable castings, and had introduced the improvements indicated by his researches, it was by no means uncommon to get results for months where the ultimate strength of the daily runs averaged 58,000 pounds per square inch, and in one case the breaking strength of a bar actually went as high as 63,000 pounds per square inch. Be it said in passing, that usually such strengths are to be deprecated, as they mean hard iron. while malleable is wanted soft and ductile. In the above case, however, some of the strong bars, tested transversely, on supports 12 inches apart (the customary method) gave deflections of 2½ inches, where ordinarily only half an inch is expected, which would indicate extreme softness.

Section of Test Bars.

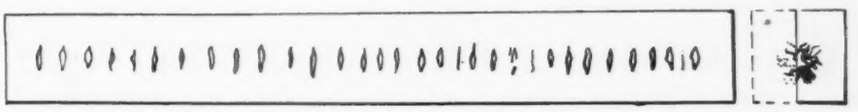
Now to look a little further into this shrinkage question. If a bar were to be sliced in two longitudinally, and the interior magnified, a regular series of cracks at right angles to the length of the bar would be found. These cracks, very marked in the center, extend outwardly only a short distance, as may be seen in observing closely the black fracture of a broken bar. The center shows up like a large snow crystal, the edges flaring outwards in streaks, never very far, perhaps one-quarter the thickness of the casting. That these spots are actual breaks in the continuity of the bar is proven by the fact that occasionally these flaring edges of the shrinkage crack communicate with the skin of the casting through some small sand hole. The shrinkage, which looks so much like the snow crystal, will then be beautifully colored, showing the effect of oxidation by the entrance of air. While this is a common observation in castings which have sudden changes in section and no provisions taken to overcome the draw of the iron, it would not be so readily expected in well made, high grade test bars. But it is the case just the same, and every test bar, and for that matter every casting may be regarded as a shell of fairly continuous metal with an interior of slight planes of separation at right angles to the surface.

Taking into account the heavy contraction of white iron this is self-evident, for as soon as the metal sets against the mold, and the source of supply is cut off, the setting interior will pull away section by section, beginning at the colder end. An exaggerated picture of the longitudinal slice above mentioned would look like a rectangle with solid rims, the interior broken only by a running series of convex lenses from end to end, showing in section standing vertical. The longitudinal section of the test bar is shown in the accompanying illustration.

It is important to remember this characteristic of malleable cast iron, as it forms the basis of many a mysterious failure in otherwise good looking iron.

Importance of Physical Tests.

In contradistinction to gray iron, the tensile test for malleable cast iron is very important. The ductility of the material allows it to be firmly and evenly gripped in the jaws of the testing machine, and hence the results are correct. The bars being cast either 1 inch square, or ½ x 1 inch, the calculations are easily performed. The elongation is taken in 2 inches.



LONGITUDINAL SECTION OF TEST BAR AND FACE OF FRACTURED BAR

The other test made is the transverse. The bars are laid flat on the knife-edge supports which are placed 12 inches apart, and pressure applied in the center. The removal of all the casting strains, etc., during the anneal make it immaterial which side of the bar (cope or drag) is laid up or down. While the transverse test is going on, the deflection is measured by an instrument placed under the bar, and a reading taken the moment of failure. From this transverse breaking weight or pressure, and the deflection it is possible to get a value for the resiliance of the metal, or its comparative resistance to shock.

Impact tests, much as they are to be welcomed, have not yet been perfected enough to cut any figure in the testing of malleable cast iron. It is only in the case of the malleable car coupler that elaborate drop tests were carried out, a standard machine as used for testing car wheels and modified for the purpose, being employed. This form of testing was ultimately abandoned as being unnecessary.

Improvement in the Quality of Malleable Castings.

The history of improvement in the malleable casting is admirably reflected in the test records of any works that has them. Going back to the early 90's, the average tensile strength of malleable cast iron was about 35,000 pounds per square inch, with an elongation of about 2 per cent in 2 inches. The transverse strength perhaps, 2,800 pounds, with a deflection of half an inch. Toward the close of the 90's things were different, and a fair average of the malleable castings then made would run about 44,000 pounds per square inch with an elongation of 5 per cent in 2 inches. The transverse strength, about 3,500 pounds, with a deflection of ½-inch as before. These, while average figures for the general run of the work, were greatly exceeded in establishments where special attention was given to the niceties of the process. The tensile strength here would run 52,000 pounds per square inch regularly, with 7 per cent elongation in 2 inches. The transverse strength, 5,000 and over, with 1½ inches for deflection.

Deterioration in Quality of Malleable Castings.

With the passing of the hard times, during which nearly all the improvements in the malleable process were applied, came a swing of the pendulum which carried the tonnage of this materal far upward. The result was an immediate deterioration in the quality of the castings. Furnaces were pushed to the limit. Steel melters took the place of many conservative and careful malleable men, and the metal suffered before it went to the anneal. The result was a drop in the quality of malleable castings, which has not been overcome to this day. Witness the specifications for these castings modified in 1904, when it was found necessary to drop the required ultimate strength from 42,000 to 40,000 pounds per square inch. There is much good malleable made in every works, but on the other hand, the scrap heaps bought from the large consumers, when examined for specimens with trade mark and approximate date on them, reveal a deplorable and unnecessary inferiority in what should be a high class product. Charge this to the incessant

chase after tonnage and high pressure production.

Drawing Down Round Test Bars.

As an interesting side light on the tensile strength of malleable cast iron, there may be mentioned the results of experiments on drawing down round test bars of various diameters. These were heated red hot and handled exactly as crucible steel bars under the steam hammer to turn out the highest grades of tool steel. It was not possible to draw the malleable bars down very far, as the interior, on account of its high total carbon, cracked up very badly. The surface, however, remained intact, and acquired a high finish for a hammered bar. The results of the hammered portions of these bars were surprising, running from some 80,000 pounds per square inch in the larger sizes to 123,000 in the smallest. If the cracked and worthless interiors were to be deducted from the area of the hammered bars, the remaining good portions would show up as good as high class rods of tool steel. In effect the sound portions of the bars approach this in structure, as the result of heating and hammering.

The writer has made some 100,000 tests of test bars in the regular course of routine, and in addition has cut test coupons from the product of practically every important producer in this country, by the hundreds, subjecting them to tensile tests. This rise in quality and later deterioration can be readily traced from these records. Perhaps the intense competition prevailing is to be blamed for some of this. Most likely, however, it is a question of delivery in rush times, and too low remuneration when things are slack.

The specifications given below, formally adopted by the American Society for Testing Materials, are well adapted to secure reasonably good material. They were gotten up by a committee of well known malleable producers as well as engineers familiar with the subject. The specifications are introduced into the text because they will be recognized as eminently fair, and are the only official ones in existence. Every point in them has a reason connected with the manufacture of the castings, as will be seen from the subsequent discussions of the melting and annealing processes.

Specifications for Malleable Castings.

Process of Manufacture.

Malleable iron castings may be made by the open-hearth, air furnace or cupola process. Cupola iron, however, is not recommended for heavy or important castings.

Chemical Properties.

Castings for which physical requirements are specified shall not contain over 0.06 sulphur or over 0.225 phosphorus.

Physical Properties.

(1) Standard Test Bar.—This bar shall be 1 inch square and 14 inches long, cast without chills and left perfectly free in the mold. Three bars shall be cast in one mold, heavy risers insuring sound bars. Where the full heat goes into castings which are subject to specification, one mold shall be poured two minutes after tapping into the first ladle, and another mold from the last iron of the heat. Molds shall be suitably stamped to insure identification of the bars, the bars being annealed with the castings. Where only a partial heat is required for the work in hand, one mold shall be cast from the first ladle used and another after the required iron has been tapped.

(2) Of the three test bars from the two molds required for each heat, one shall be tested for tensile strength and elongation, the other for transverse strength and deflection. The other remaining bar is reserved for either the tensile or transverse test, in case of the failure of the other two bars to come up to requirements. The halves of the bars broken transversely may also be used for the tensile test.

(3) Failure to reach the required limit for the tensile test with elongation, as also the transverse test with deflection, on the part of at least one test rejects the castings from that heat.

(4) Tensile Test.—The tensile strength of a standard test bar for castings under specification shall not be less than 40,000 pounds per square inch. The elongation measured in 2 inches shall not be less than 2½ per cent.

(5) Transverse Test.—The transverse strength of a standard test bar on supports 12 inches apart, pressure being applied at the center, shall not be less than 3,000 pounds, deflection being at least ½ of an inch.

Test Lugs.

Castings of special design or specal importance may be provided with suitable test lugs at the option of the inspector. At least one of these lugs shall be left on the casting for his inspection at his request therefor.

Annealing.

(1) Malleable castings shall neither be "over" nor "under" annealed. They must have received their full heat in the oven at least 60 hours after reaching that temperature.

(2) The "saggers" shall not be dumped until the contents shall be at least "black hot."

Finish.

Castings shall be true to pattern, free from blemishes, scale or shrinkage cracks. A variation of 1/16 of an inch per foot shall be permissible. Founders shall not be held responsible for defects due to irregular cross sections and unevenly distributed metal.

Inspection.

The inspector representing the purchaser shall have all reasonable facilities given him by the founder to satisfy him that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made prior to shipment.

Resilience of Malleable Cast Iron.

In addition to the records of the tensile and transverse tests, the founder can also get a comparative idea of the value of his material for resisting shock. The resilience of malleable cast iron, as this is called, is measured by the product of the breaking weight times the deflection at that point, divided by twice the weight of the metal between the supports. This will give an arbitrary figure, let us say 680. By watching this from day to day, the iron ranging from 500 up to 1,650 for example, a very fair idea of the manner in which the castings run will be had.

Conclusion.

In concluding this general discussion of the testing of malleable cast iron, it may be said that for general purposes it is not altogether desirable to have a metal very high in tensile strength, but rather one which has a high transverse strength, and especially a good deflection. This will mean soft ductile metal which adjusts itself to conditions much more readily than a stiff strong product. It is not always that a strong and at the same time soft material can be produced in a foundry operating on the lighter grades of castings. The purchaser therefore, unless he requires very stiff material, should rather look upon the deflection of the metal coupled with the weight it took to do this bending before failure, than for a high tensile strength.

ORNAMENTAL GRAY IRON CASTINGS

Practice Followed in the New Plant of the Flour City Ornamental Iron Works

BY H. COLE ESTEP

MINNEAPOLIS is the home of a new foundry, unique in design, operation and product. This foundry, which is a part of the plant of the Flour City Ornamental Iron Works, is devoted exclusively to the manufacture of ornamental iron and bronze castings. Where the average foundry is designed for the economical handling of heavy castings and the cheap production of large quantities of duplicate pieces, this plant is prepared to execute a large number of individual orders in which few separate pieces will weigh over a thousand pounds, while the duplication of any great number of castings from a single pattern is the exception rather than the rule. The average foundry aims to turn out soft, tough castings that will wear well and can be easily machined; the output of this plant must first of all have a good appearance, wearing qualities, in an engineering sense, are of secondary importance. The production of castings that will sharply reproduce all the delicate tracery of complicated ornamental patterns is the fundamental aim in the operation of the plant. The output must be distinguished for its beautiful and esthetic qualities; although utility and strength are taken into account they are not the primary considerations. In this line of work we have what is probably the only example of the employment of modern engineering science and methods in the manufacture of a product essentially artistic in character. Both the plant and its work are well worth description.

The company owns a tract of land 700 x 400 feet, situated adjacent to the main line of the Chicago, Milwaukee & St. Paul railroad in South Minneapolis. Out of a total working force of 425 men, 70 are employed in the foundry. On account of the nature of the work the men are paid on the day rate system. Following the custom of other local foundries, No. 1 gray Hinckley or southern pig and standard Connellsville coke are used.

The Foundry.

The foundry building is a fireproof, substantial steel frame structure with walls of brick and glass. The building is 200 x 75 feet in size, subdivided as follows: Molding floor 75 x 150 feet; cleaning room 50 x 75 feet; pattern storage and modeling room on the second floor above the cleaning room, 50 x 50 feet and 75 x 20 feet, respectively. The molding floor covers 11,250 square feet. Fifty per cent of the wall space in the molding room is glass. In addition to this there is a skylight 20 feet wide and 150 feet long, extending the full length of the floor. Excepting at the close of the short days in widwinter artificial light is never necessary. The artificial light is supplied by five 1,500-candle power arc lamps evenly distributed over the floor space and supplemented by incandescent globes where necessary.

The floor is of conventional design consisting of a central bay directly under the skylight and two side avenues, each 25 feet in width. Two rows of steel columns extending down either side of the central bay carry seven steel trusses which in their turn support the roof. Compressed air is furnished to various points on the molding floor for the purpose of operating mechanical riddles and similar devices. Power is furnished to the foundry by a 50-horsepower rope drive, consisting of two 1-inch ropes running over 48-

FIG. 1—GENERAL VIEW OF THE FOUNDRY SHOWING THE JIB CRANES

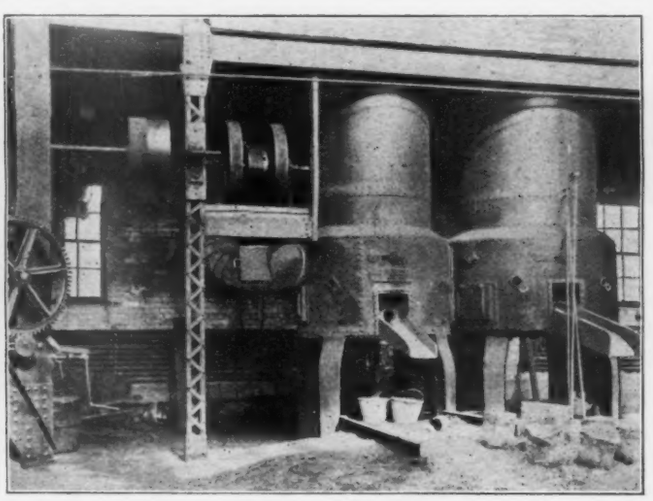


FIG. 2—THE TWO CUPOLAS

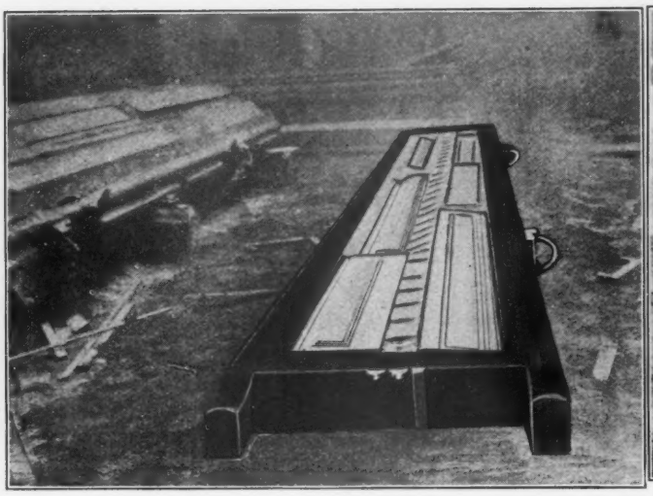


FIG. 3—DRAG OF A SKIN-DRIED MOLD CONTAINING 1,000 POUNDS OF ORNAMENTAL PLATES. NOTE THE METHOD OF GATING

FIG. 4—COPE OF A SKIN-DRIED MOLD CONTAINING 1,000 POUNDS OF ORNAMENTAL PLATES

inch cast iron pulleys. The rope drive runs a line shaft which extends along one side of the building from the cupolas to the end wall; power for the cupola blower, tumbling barrels, elevator, etc., is belted from this line shaft.

Cupolas.

Midway down one of the side avenues are situated the two cupolas. They are unenclosed, standard in every respect and were both built by the Whiting Foundry Equipment Co., Harvey, Ill. One is 46 and the other 50 inches in diameter. The blast is furnished by a 36-inch Sturtevant cupola blower driven from the nearby line shaft. The blower equipment is situated immediately adjacent to the cupolas, suspended from the charging floor beams, and is completely unenclosed and accessible. The blast pipe is 18 inches in diameter and has but one bend. This large, practically straight blast pipe together with the accessibility and simplicity of the whole arrangement makes it a distinctly commendable design.

The core room, 25 feet square, is situated in the southeast corner of the building. There is one core oven, 15 x 8 x 7½ feet in size, furnished with a 3-foot gage track and the usual core truck. This oven is built out beyond the outside wall of the building and thus occupies no space in the molding room.

One corner of the molding floor is devoted to the brass and bronze castings' department. The brass melting furnace has a capacity of eight crucibles; it is of standard design with mechanical draft and the fire pot situated below the floor level. The pots are manipulated by means of the usual crucible tongs in the hands of the furnaceman.

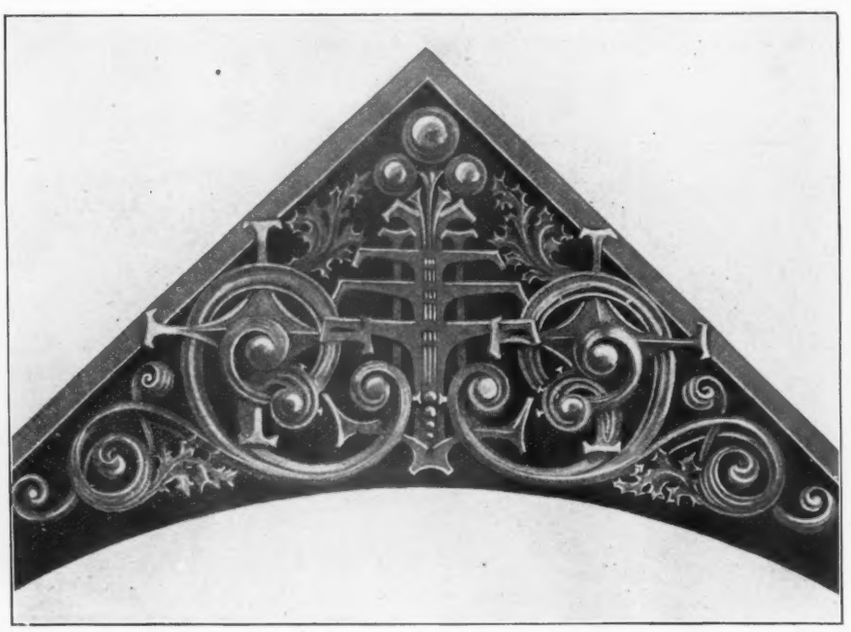


FIG. 5—WAX MODEL OR PATTERN OF ORNAMENTAL BAS-RELIEF

Crane Equipment.

In the crane service and other arrangements for internal transportation we find the first distinctive feature that differentiates this plant from the normal gray iron foundry. Instead of the usual electric traveling crane we find three, 25-foot radius, 10-ton, steel framed jib cranes. One stands near the cupolas and the other two are situated on the opposite side of the main aisle. The three are so arranged that their radii intersect, thus facilitating the passage of material from one crane to another when necessary. These three cranes reach every point in the main bay of the molding room. They are operated entirely by hand. This arrangement of hand power jib instead of mechanically operated traveling cranes was adopted for two reasons. There is little occasion, in this plant, to pass heavy flasks, ladles or castings from one point in the room to another, but some provision is necessary for the simultaneous handling of two or more heavy copes situated at different points on the floor. With a single traveler some parts of the shop would be continually killing time "waiting for the crane," while with this arrangement each floor has its own crane and the work goes on continuously. Secondly, a great many of the castings are in the nature of large flat plates, embellished by ornamental work. Some of these are 20 feet long, 2 or 3 feet wide and often not more than ⅜ of an inch thick. The copes of these molds require ex-

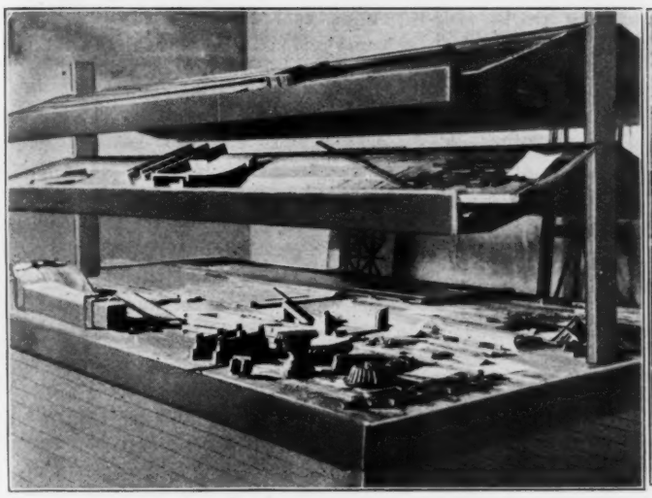


FIG. 6—RACK FOR STORING LIVE PATTERNS

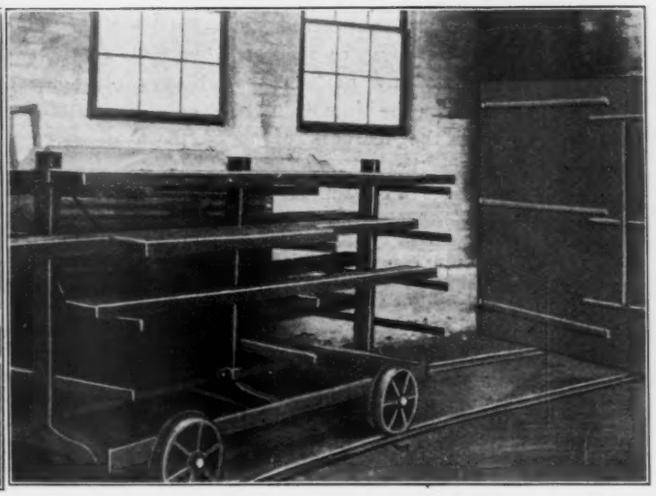


FIG. 7—CORE TRUCK AND CORE OVEN

tremely careful and gentle handling in order to avoid caving in and the consequent ruination of the mold at the last minute. This steadiness and gentleness of manipulation can only be obtained by the use of hand operated jib cranes; there is a certain amount of jerk and shock in the power cranes that experience has shown is fatal in this class of work.

The castings are carried to the cleaning room and thence to the finishing departments on small flat-tired trucks which can be wheeled to any part of the shop. Most of the work being comparatively light, this method of transportation has been found to be more satisfactory than the inflexible tramway system.

Cleaning Department.

Buggies laden with coke and iron are carried to the charging floor on an 8 x 8-foot elevator operated by belt power from the line shaft. The charging floor itself is rather small, being 15 by 18 feet in size, and contains just enough space for the scales and for storing the various charges of one heat.

The cleaning room, 75 x 50 feet in size, is considerably larger than is usual in a plant of this capacity. It is properly located adjacent to one end of the molding floor, and is directly connected on one side to the assembling and shipping departments. The ceiling is high, the windows are large, the room is light. Along one side, near the line shaft, are a row of 36-inch rattlers; opposite these is the sand blasting apparatus. On account of their ornamental character most of the castings require hand treatment; these are cleaned and chipped in the center of the room. As a final touch every casting is thoroughly scoured under a sand-blast and leaves the room absolutely clean and smooth.

The sand is stored in a large bin at the rear of the molding room. The coke and iron are conveniently stored near the charging floor elevator. The pigs are placed in neat piles, while the scrap is heaped in a nearby bin.

Modeling Room.

One of the distinctive features of the plant is the modeling room. Rough sketches of the ornamental scrolls, medallions, memorial tablets, etc., which are ordered are furnished to the model department either by the architect or by the company's own designer. From these sketches an unusually skillful and expert clay modeller makes full size clay models of the final casting. When finished the models are photographed and a print is sent to the architect or proper authority for approval. Upon the receipt of this approval a plaster-of-paris mold, or negative, is made of the clay model, from which negative a wax cast or pattern is produced. This wax pattern, backed up and stiffened by a plaster-of-paris follow board, is considered to be "strong enough for a molder to walk on", and is sent to the foundry where it is used like an ordinary wooden pattern in making the final sand mold. The modeling room fronts on the street, is light and cheery as it should be, and were it not for the cleaning room below and foundry immediately adjacent, might easily be taken for a clay modeller's studio.

The patterns are stored in a large dry room 50 feet square, located just back of the modeling room. The pat-

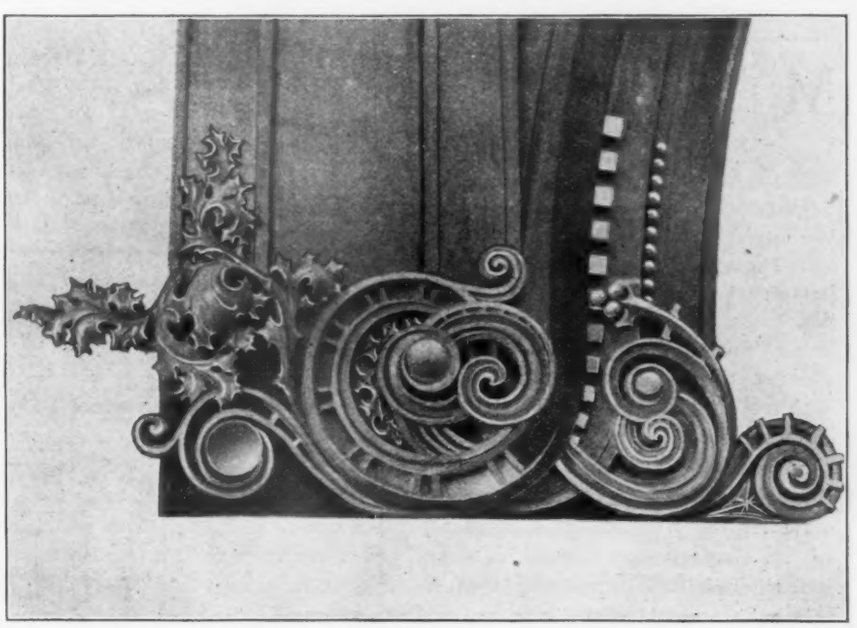


FIG. 8—WAX MODEL OF ORNAMENTAL SCROLL

terns and shelves are numbered and the contents of the room are accurately indexed so that any pattern that may be desired can be found immediately. One of the features of the pattern storage is the segregation of the "live" patterns, those immediately wanted in the foundry, from the bulk of the stock. In the passageway just outside of the pattern store room is an iron rack containing several shelves, which are accessible from all sides. Each "live" pattern is placed on one of these shelves, together with the shop order covering the job in which it is included. By virtue of this system those patterns which are immediately wanted in the shop can always be instantly obtained; also an inspection of this rack tells the foundry foreman at a glance, just what work he has ahead, permitting him to arrange the shop routine accordingly.

In addition to the model room there is a pattern shop located on the second floor of a building immediately adjacent to the foundry. The shop is 60 x 80 feet in size and employs 25 men. It contains the usual array of woodworking tools, is light, clean, fireproof and thoroughly up-to-date.

Molding Ornamental Castings.

The molding of ornamental iron castings differs in a few important particulars from ordinary work. Imperfect castings cannot be tolerated. Every piece must be true, sharp and accurate with no blow holes, shrinkage holes, cold shorts or other imperfections which can often be machined off in an ordinary casting. A heavy proportion of the work comes in the form of large, thin ornamental plates or girders. These are extremely difficult to cast perfectly. In order to secure good results special precautions are taken with the molds. The copes are carefully fitted with new cross bars placed at intervals not greater than 5 inches, while more than the usual number of gaggers are inserted to prevent the cope sand from caving into the drag. The sand is rammed carefully and evenly so there are no soft spots. As a final touch, each mold is sprinkled with a thin layer of fine, sharp sand and thoroughly skin dried with a gasoline blow torch. The skin drying insures a perfect mold which will retain its shape, and not wash away under the influence of hot metal. The gates are large and carefully distributed so the mold will fill evenly and rapidly; the risers are unusually large. One flask which the writer saw was 24 feet long, and 4 feet, 8 inches wide; it contained 3 ornamental plates about ⅝ inches thick and weighing 500 pounds each. This flask was poured through 5 runners, and also contained four risers.

Mixtures.

Gray iron containing phosphorus up to 0.55 per cent is used. The metal is poured extremely hot; the temperature ranges from 2,500 to 2,550 degress Fahr. To obtain this temperature a somewhat larger proportion of coke is charged than is usual. A typical charge of 9,000 pounds is as follow: Bed charge of coke 1,000 pounds, followed by 500 pounds of gray southern pig and 500 pounds of first class machinery scrap; second, third, fourth and fifth charges of coke, 150 pounds, each accompanied by 1,000 pounds of pig and 1,000 pounds of scrap. Total coke charged 1,600 pounds; total iron charged 9,000 pounds; ratio of coke to iron 1 to 5.6. Blast pressure 10½ ounces. Running the iron white, seething hot is the key to success in ornamental founding.

The Flour City Ornamental Iron Works was organized in 1893 and is now incorporated in Minnesota with a paid-up capital of $100,000. The officers of the firm are all men of wide practical experience in the ornamental iron business. They are: Eugene Tetzlaff, president and general manager; William Burns, vice-president; Ernest Rubbert, secretary and treasurer.

CHARGING MACHINE FOR CUPOLAS*

BY G. R. BRANDON

MACHINES similar to those which will be described in this paper are in successful operation and are practical, both from mechanical and financial standpoints. The very simplicity of the work of collecting charges and of the operation of charging itself has induced neglect of this important department. A little study into methods might lead to the adoption of a more efficient vehicle for carrying charges, the use of cars, for example, with roller bearings and running on tracks, instead of wheelbarrows. The arrangement of tracks to permit through routing and the location of a scale for the weighing of charges are of an importance frequently overlooked, and it is surprising that in this enlightened day the long inclined plane taking up much valuable space and with its laborious methods is still used in place of the modern foundry elevator.

Where the material handled is in sufficient quantity, a quick acting electric traveler should be installed to cover the entire stock yard, to unload pig

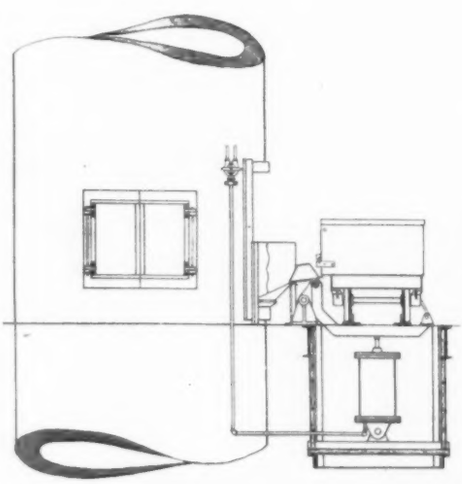


FIG. 1.—CUPOLA CHARGING MACHINE IN LOW POSITION

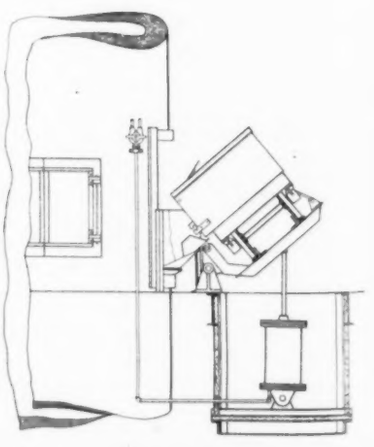


FIG. 2.—CUPOLA CHARGING MACHINE IN DUMPING POSITION

*Read at the March meeting of the Pittsburg Foundrymen's Association.

iron, fuel and supplies and also to handle flasks. A magnet can be used for handling pig iron, and a drop ball for breaking scrap with distinct advantage. Charges may be collected from different parts of the yard and raised to the charging floor with a crane at minimum expense. The charging operation lends itself to power manipulation and, consequently, at this point we may also obtain a saving in labor. This paper describes the charging machine developed and manufactured by the Whiting Foundry Equipment Co., Harvey, Ill.

We are indebted to the blast furnace operators for the idea of the charging machine. The skip hoists and the great saving effected over the old practice of using elevators and dump buggies pushed by laborers is familiar. This refinement in handling charges naturally was introduced by the blast furnace people, as their operations are continuous for months, 24 hours a day. The elimination of laborers effected great economy in the cost of production and is one of the reasons why pig iron can be purchased at such low prices—occasionally.

The skip hoist is an end dump and is fitted with automatic features which would not be applicable to the conditions in cupola practice. There have been end dump machines used for cupolas and we believe that such a device is in use by the Pennsylvania Car Wheel Co. We have adopted the side dump, which is claimed to be a simpler design and a better arrangement for the continuous movement of cars. Other advantages are that there is less handling of cars and a narrower charging floor is permissible.

The construction of the Whiting pneumatic machine is illustrated in the drawings. Fig. 1 is an elevation of the machine with car in position ready for raising, and Fig. 2, the same in dumping position.

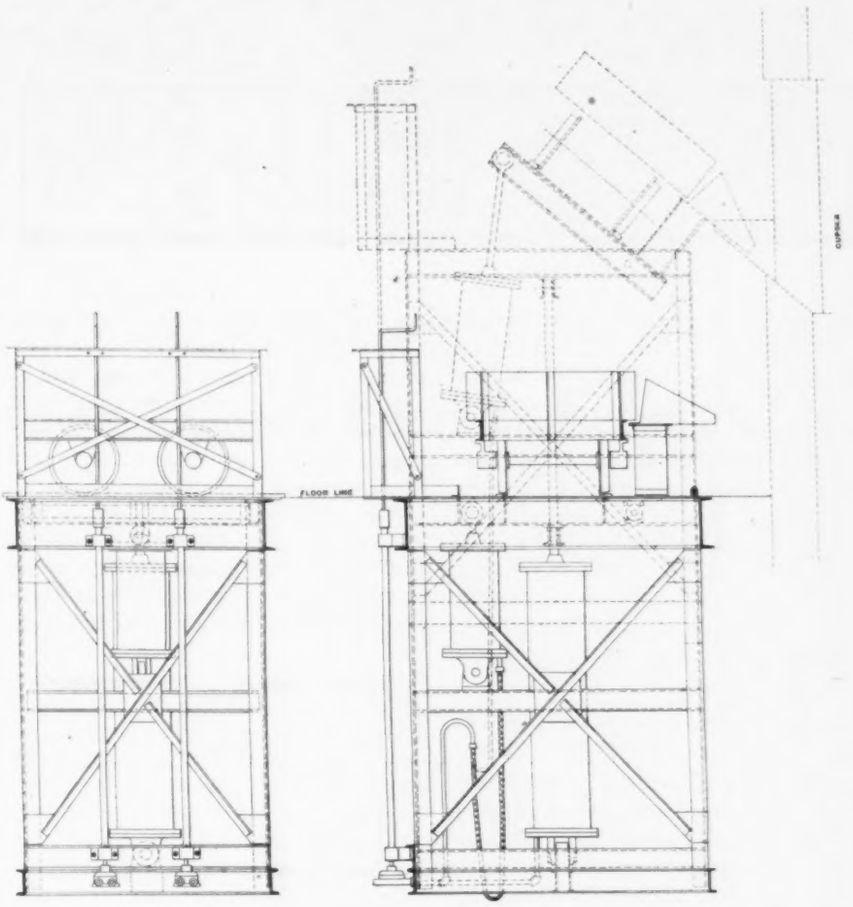


FIG. 3—COMPOUND CUPOLA CHARGING MACHINE

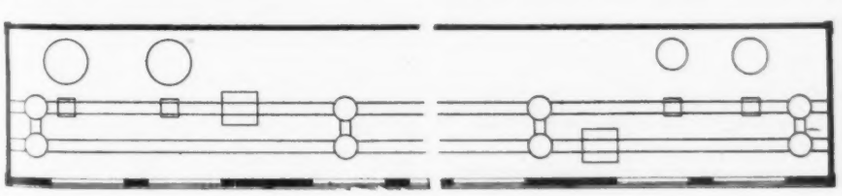


FIG. 4—PLAN OF CUPOLA CHARGING FLOOR OF CANADA CAR CO.

The machine consists of a platform hinged at a level above the charging platform on the side toward the cupola, provided with a track for the charging car, in line with stationary tracks, guard angles, as shown, and a hook for holding the car to the platform when being dumped. A dumping cylinder is properly supported by framing attached to the charging floor and pivoted to allow the alignment required. The piston rod is pivoted in a bracket attached to the under side of the platform. The platform is constructed of structural shapes and all joints are strongly riveted; the hinge pins are of ample size and are arranged for easy removal and replacement. An apron plate is hinged to the platform and laps over an inclined chute in front of the cupola door. The controlling valve is located at any convenient point and is piped to the cylinder and connected with an air supply.

In operation, the car is run on the platform and the hook engaged with an eye attached to the car frame. Then the valve is opened to admit air into the operating cylinder and the platform is raised to the dumping position. Iron charges are put on cars with ends about 12 inches high, but open on both sides. Coke cars have their ends and sides enclosed, one side being fitted with a hinged door.

Through manipulation of the valve, charges may be distributed as desired. The level of charges must be maintained 3 to 4 feet below the level of the door sill to get the best results.

Electric power may be used in place of compressed air, by using a geared hoisting machine. The ordinary crane controller will give the different movements and speeds required.

A device of this character is necessarily of the greatest benefit where the cupola output is large and the speed of melting relatively high. A cupola 54 inches diameter inside of lining is about the smallest size which should be charged by machine. With a No. 9½ Whiting cupola, 90-inch shell, 72-inches inside diameter, and melting 20 tons per hour, two men with the charging machine can perform the work which would otherwise require five or six men. Assuming the duration of the heat to be four hours, the saving in labor will be 12 hours' time

at, say 17½ cents, or $2.10 per day, which represents an annual saving of $630, or about 200 per cent on the investment.

The charging door in the cupola for use with this machine is 9 inches above charging floor. To obtain the maximum economy of fuel the charging floor should be from 20 to 24 feet above the bottom plate, or about 5 feet higher than for hand charging.

Other charging doors, at ordinary height for hand charging, are located at the sides for use in emergency, and for leveling the stock charged by the machine if this should ever be necessary.

We have devised, as shown in Fig. 3, a compound machine for use in connection with low charging floors, consisting practically of an elevator of the plunger type, which lifts the car and charging machine together to the required level. The two mechanisms are controlled independently and may be operated by pneumatic power as shown or by electric power. The original charging doors may be left in the cupola, being shifted as necessary and used for hand charging and leveling.

A few diagrams showing actual layouts of charging floors and tracks may be of interest. Figs. 4 and 5 represent the cupola charging department of the Canada Car Co., Montreal, Que. There are two No. 9½ Whiting cupolas for the wheel foundry and one No. 7 and one No. 4 for the gray iron foundry. All are equipped with charging machines. The two foundries adjoin and the charging houses are connected, giving ample track space on the charging floor, and providing storage facilities below, which is desirable in that rigorous climate. The tracks on the charging floor are arranged with crossovers so that cars may travel continuously without interference. On the ground floor layout, Fig. 5, is shown the location of the scales in relation to the elevator and the arrangement of tracks which permits the passing of empties to the yard, without interfering in any way with loaded cars ready to be elevated to the charging floor.

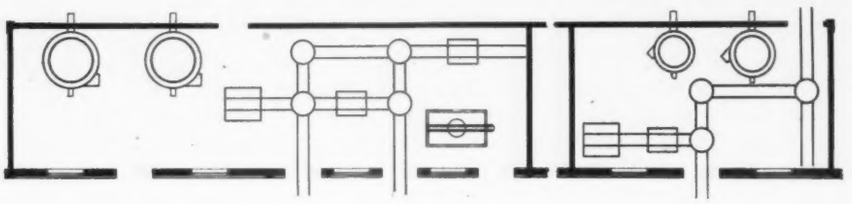


FIG. 5—GROUND FLOOR PLAN OF CUPOLA CHARGING DEPARTMENT OF CANADA CAR CO.

Fig. 6 shows the layout of the ground floor and Fig. 7 of the charging floor for the wheel foundry of the American Car & Foundry Co., at Madison, Ill. Two No. 11 Whiting cupolas are used in this foundry and both are charged by pneumatic machines. The special location of elevators was necessitated by the peculiar yard arrangement. The end elevators are used for iron and the one on the side for coke. Each cupola is served by the elevator nearest to it in ordinary operation.

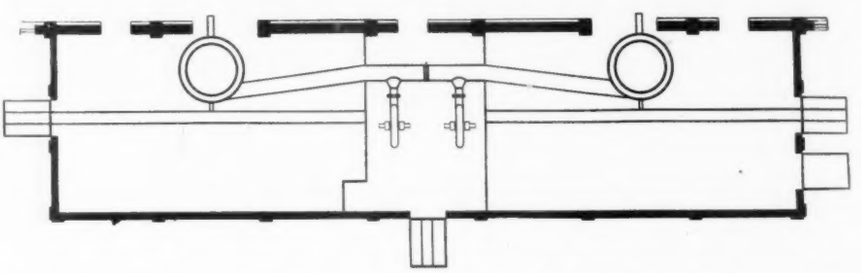


FIG. 6—GROUND FLOOR PLAN CHARGING DEPARTMENT, AMERICAN CAR & FOUNDRY CO., MADISON, ILL.

The tracks on the charging floors have storage capacity for about 70 cars. A transfer table at each end is arranged so that a loaded car from the elevator may be transferred to any storage track; turntables in the middle provide passage from any one track to the other, and empty cars are transferred from the charging track to elevator, thus completing the circuit.

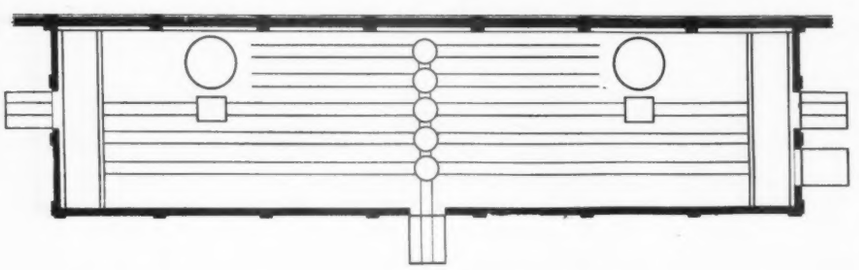


FIG. 7—CHARGING FLOOR, AMERICAN CAR & FOUNDRY CO., MADISON, ILL.

CASTING ALUMINUM IN IRON MOLDS.

Question:—Do you know of any method of casting aluminum or any mixture containing aluminum in permanent cast iron molds?

Answer:—When casting aluminum in permanent molds the latter should be heated to a temperature of 120 degrees Cent. and should be coated with a solution of bismuth oxide containing one part of oxide to 10 parts of water. When the casting has been poured it should be removed from the mold as rapidly as possible. A high percentage of sulphur in the iron from which these permanent molds are constructed, frequently results in their rapid deterioration owing to the action of the aluminum. Low sulphur iron should be used in making molds of this kind. In constructing the molds an effort should be made to have the walls of an even thickness throughout. The temperature at which the aluminum is poured is also an important factor. The metal should not show a reddish tint, as then it is overheated and will expand too much in the mold.

EMIL B. HORNE.

Answer:—Reproducers for phonographs are the only aluminum castings the writer knows of that are cast in iron molds. White brass, an alloy of zinc, copper and aluminum, is cast in iron molds without difficulty, the metal being improved by casting in this way. In making car journal brasses of this metal in iron molds, the writer merely heats the molds and brushes them with plumbago. Sometimes it is necessary to agitate the metal while solidifying, and this can be done by striking the mold with a copper hammer.

C. VICKERS.

Second Annual Exhibit of Foundry Equipment Under the Auspices of the Chicago Foundry Foremen

THE SUCCESS of the second annual exhibit of foundry supplies and equipment held under the auspices of the Associated Foundry Foremen of Chicago and vicinity, at the Lewis Institute, Chicago, Thursday, Friday and Saturday, March 5, 6 and 7, is reflected by the registration which showed an attendance of 568 foundrymen. More than 200 of this number came from points outside of the Chicago district, and no less than 16 states were represented. The rooms and equipment of the Lewis Institute were placed at the disposal of the exhibitors and the members of the Associated Foundry Foremen and their guests, and every facility was provided for the practical demonstration of molding machines and foundry appliances.

Meetings were held in the auditorium of the institute on Thursday and Friday evenings, and on Saturday the convention closed with a smoker at the Sherman House, which was attended by more than 200 foundrymen.

The first meeting, Thursday evening, was called to order by E. W. Smith, president of the Chicago organization, who very briefly referred to the advancement in foundry practice shown by the various devices exhibited.

Such an exhibition, he said, as the Chicago Foundry Foremen's Association was conducting was worthy in that it presented to the men of the foundry in the most beneficial way these various improvements. An invitation was extended to attend the regular meetings of the association, and the thanks of the organization was tendered to Lewis Institute and all those who had given assistance to the project.

C. C. Kawin, of Chicago, was then introduced. He spoke informally of the work of the commercial chemist in the foundry and recounted the difficulties and prejudices that attended former attempts to introduce technical and chemical methods into the dogmatic atmosphere surrounding the superintendent who bought iron by fracture and saw little need for other methods. Mr. Kawin laid stress on the fact that the elements entering into the composition of iron were definite in number; that each had a definite effect on the iron depending on relative proportions, and that a chemical determination of just how much of each was contained told the whole story of the iron's character.

This all-sufficiency of chemical analysis he qualified, however, by citing certain physical treatments of iron in the foundry that may be used to open or close the grain, and he pointed out from this that a mutual helping of each other should be the object of chemist and foundryman. Education should be the common aim of both and the uniting of the special knowledge of each would result in a double benefit to both.

The program gave the remainder of the evening to the presentation of cinematograph views of the French system of universal molding by E. H. Mumford, of Philadelphia, but preceding this the president called upon H. M. Lane, secretary of the Foundry Supply Association, who took occasion to commend the local association for fostering the exhibition idea and thus assisting national associations in making a success of such conventions as the one to be held in Toronto in June.

The subject presented by Mr. Mumford was covered in the January issue of THE FOUNDRY, following the showing of the cinematograph views before the November meeting of the association.

Friday Evening.

On Friday evening, with Director G. N. Carman, of Lewis Institute, presiding, the convention was addressed by Dr. Richard Moldenke and E. A. Johnson, director of foundry work at Winona Technical school, Indianapolis. Dr. Moldenke discussed "Foundry Waste," as follows:

In these times of serious industrial depression perhaps no subject should receive greater attention than the prevention of waste. In the rush of the high periods of our national prosperity there is all too often forgotten the axiom that "waste means want." In view of the present attempt to hold up the natural laws of supply and demand, we will undoubtedly have ample opportunity to take stock of the situation, and to apply every possible remedy in our establishment until material and labor comes down to normal conditions. As this eventually may be considered a foregone conclusion, now is the time to plan improvements to do away with wasteful methods of manufacture. When the low level has been reached, these improvements should be completed, so that when the next rush comes, conditions nearer the ideal as we now know it may reign, and our national prosperity be correspondingly enhanced.

EXHIBITS OF FOUNDRY EQUIPMENT AT THE LEWIS INSTITUTE

ARCADE MFG. CO.
S. OBERMAYER CO.

INGERSOLL-RAND CO.

FALLS RIVET & MACHINE CO.
FOX MACHINE CO.

Let me say at the outset, that genuine improvements do not necessarily mean a cutting down of the wages of employes, but rather the opposite. Brains are worth money, but manual labor should be turned over to the coal pile as much as possible. The time is fast approaching when our knowledge of metals and materials will be such that what was formerly considered an art will be so simplified that men with less skill operating on machines will turn out as good if not a better product than is the case today. This will not hurt the present supply of highly skilled men, but rather enable them to turn their art to better account in higher positions, supplying their brains to keep the wheels of industry running smoothly.

In passing through many foundries in this great country, I have often been tempted, on seeing the end of a lump of iron stick out from behind a lot of rubbish in a corner, to take a silver dollar from my pocket and ask the foundry foreman to throw it in there also. The point is generally quickly understood, for there are several good dollars, even if in iron and not silver, lying idle and destined to be buried or lost in some other way.

Recovery of Iron.

While in Pittsburg in my earlier days, I usually had some 50 pounds of dynamite in my office continually for use in blowing up salamanders as they were unearthed in the foundry in making changes in the furnaces and plant generally. From what one hears of the burial of "accidents and mistakes" in that city, its manufacturing districts must be veritable mines for salamanders and bad castings. This is the case doubtless in other cities, and yet every bit of that material should go into the cupola or basic steel furnace. In other words, the foundry foreman working in the interests of his employers can save quite a lot of waste in iron during the course of a year. Every foundry of any account should have an electro-magnetic separator for the shot made, as well as a slag barrel for the same purpose. I have known these separators to pay for themselves in three months, and saw one some time ago put on the dumping pile of the foundry waste, which was paying handsomely in iron recovered.

Saving in the Core Department.

Who has not gone through the subject of saving the unburned portion of the cores used in the foundry and profited thereby? How many foundrymen will allow their foreman to experiment with binders and mixtures until the proper one is found giving the greatest satisfaction at the least cost? And yet unless this is done for every new set of conditions arising, there is a positive waste. The old way of putting on a higher profit on a job, or letting it go elsewhere is about at an end, as the number of "sleepers" among customers is not as great as it was formerly.

General Arrangement of the Plant.

To take up the subject a little more systematically, we must first start with the general layout. If the means of communication in the foundry or manufacturing establishment are not at once simple and effective, no time should be lost to make them so, even if walls have to be cut, and a general rearrangement of the departments results. This can be accomplished slowly and without disturbing conditions of work too seriously. Next, proper light and ventilation should be provided. There should be no dark corners and too convenient gates. An electric light plant of ample capacity is a good investment. The use of torches and dirty windows is waste. Heavy smoke induces cessation of work that has money value. Means should be provided to carry iron to every point in the foundry without breaking down men. Whether crane or overhead rail, this should go fairly fast, as time is money. In the larger shops small jib cranes save money in allowing a molder to handle his own work without disturbing every one near him. All this comes under the head of equipment which makes the first cost of the foundry higher, but saves waste of labor, meaning thereby money.

We could add to this air equipments for chipping, molding, cleaning, and what not. These things you know of and many installations can be bought on terms which practically allow them to pay for themselves. In such a case never hesitate to add them to the shop. They save waste.

Molding Sand.

Perhaps the one thing to which the least attention is given is the molding sand and molding problem. This probably because it is thought that we can learn little more in these directions. And yet this is a serious mistake. We, of all the countries, are furthest behind in the matter of preparing our molding sand. It is still too cheap. We sometimes buy ground sand because we think we are getting a better material, and find roots and soil in it. I venture to say that no foundry foreman is entirely satisfied with his sand. He would always like to have it better. Now this is no fault of the sand man, for he gives his best. He even mixes and treats it for his customers so that they have the best possible chance for fine castings. The trouble is that we do not yet know enough about the physical constitution of a molding sand to give it the proper treatment.

The ideal conditions are those in which any amount of pounding will not prevent proper venting, and yet the sand must be able to bond properly. At the same time it must be refractory to a high degree, and stand repeated applications of melted metal without spoiling too much of it.

The sand merchant is as anxious as the founder to know more of the principles underlying the whole subject, for with a sand that can turn out the best class of work on molding machines or the floor without the highest skill, it means the release of a lot of good men who may be placed over small departments under the general foreman, and use their heads and not their hands in holding up the efficiency of the shop.

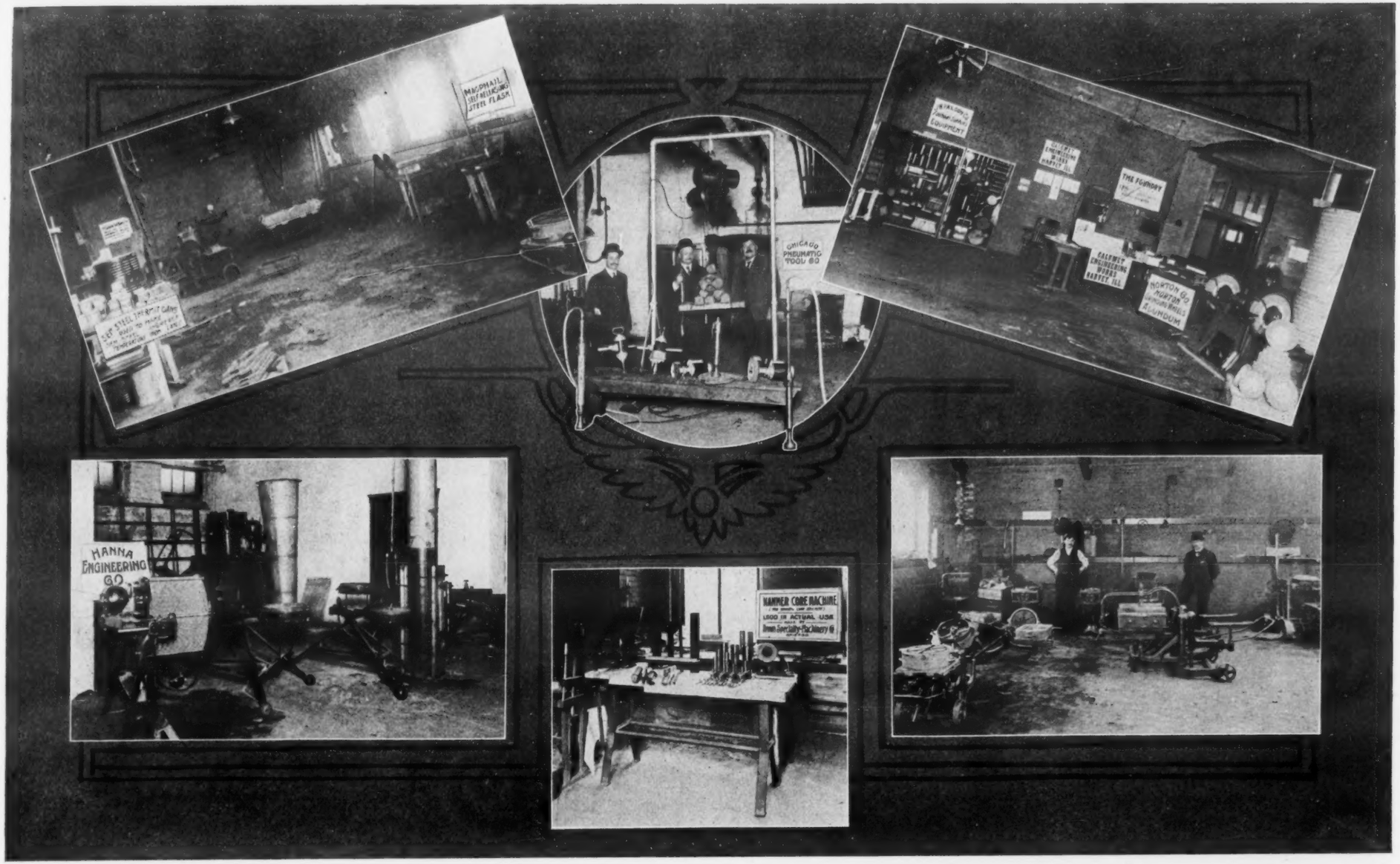
The American Foundrymen's Association is giving considerable attention to this matter from the standpoint of the art of founding, leaving the practical application to the individual.

Molding Machine.

The greatest elimination of foundry waste ever brought about was due to the introduction of the molding machine. Even perfect as these machines are becoming, 50 years from now we will think them crude. Just think for a moment how the success of a molding machine is tied up with the sand used on it. Correct this element of uncertainty, and a further step in the direction of the elimination of waste will have been accomplished.

Ignorance of Employes.

The next greatest waste in the foundry is the loss through ignorance of the molder's art on the part of the men in the shop. The discount and time cards speak for this. What is badly needed in instruction, continually given day in and day out, to the men engaged in molding, coremaking and other occupations requiring skill. The foreman has his hands full with the larger questions. He cannot go into the small details, and yet these neglected, the waste is great. The old custom of piling up the molder's bad castings for inspection during the dinner hour is a good one, but still better



EXHIBITS OF FOUNDRY EQUIPMENT AT THE LEWIS INSTITUTE

GOLDSCHMIDT THERMIT CO.
TABOR MFG. CO.
SANDWICH MFG. CO.
MACPHAIL FLASK & MACHINE CO.
HANNA ENGINEERING CO.

CHICAGO PNEUMATIC TOOL CO.
BROWN SPECIALTY MACHINERY CO.

J. W. PAXSON CO.
CALUMET ENGINEERING CO.
NORTON CO.
HENRY E. PRIDMORE.

is an interview with him at his bench or floor by an expert specially engaged to do this under the foreman's direction. How many of our larger shops have this system in operation?

Look at the waste of money in every foundry you can think of. In the larger classes of work, the loss of pieces is small, but the time taken for molding is considerable. How often can this not be cut down effectively by proper appliances. For small castings the usual custom is to pay by the piece, with perhaps a premium attached for extra efficiency. But how many bad castings are made which could have been avoided by proper instructions, not to speak of the greater output per flask if the mixing and melting of the metal were made more perfect.

I will say right here that one of the most notable improvements I have seen in recent years is the desire on the part of foundry foremen and superintendents to acquire every scrap of information it is possible to get hold of. They have realized the importance of this far quicker than their employers, and therein really lies the hope one has for future improvement in the industry. The foreman of today is just as able to calculate a mixture as the chemist. He may not yet understand the action of the elements entirely, but with the aid of night schools, by reading and asking questions, he will soon secure the information that he requires. The general movement for industrial education is not only the result of effort on the part of the employer, but also the willing acceptance of the idea by those who will eventually profit by it.

Improper Melting Methods.

Now, taking more particularly the metallurgical end of the foundry, we find a direct waste in improper melting methods. How often have I not found a 2,000-pound charge consisting of the usual pig irons and scrap, and a 500-pound ladle to tap into. And then there was worry about porous or otherwise defective castings. To come right down to a question of daily practice, inasmuch as the bed of a cupola coke charge is fixed by the desired capacity to hold iron and location of the melting zone (only the coke above the tuyeres being effective, the rest so much filling to rather cool the iron than heat it) why is the first charge of iron used? The melting of this lowers the coke bed seriously, the succeeding second charge of coke not bringing it back to the same place it had originally. Now as the iron and the coke come down in the succeeding charges this level may be raised again, even above the original bed, with the result that oftentimes the last coke charges must be reduced to get proper results. A much better practice would seem to be to make all the iron charges small, the first as well as the last, dividing the coke so that the proper ratio is kept for the whole run. This gives the smallest variation of the coke bed, and as I have always found, the most uniform iron. After all, it would seem that our old foundrymen were not so far off when they first put in their bed of anthracite, then charged so many shovels of scrap, so many pigs, then some more anthracite, the metal again, all in very small quantities. They did make castings that are our admiration for quality today though we consider the melting methods crude. I will only say that with even large diameter cupolas, where the work has to stand water pressure tests, and hence must be perfectly uniform in character besides correct in composition, the above method of very small charges of 500 pounds of metal and the corresponding coke directly from the bed up, gives excellent results when the old big charge method fails.

Cupola Practice.

Now in cupola practice, saving is in most cases waste. I strongly deprecate the attempt to get high melting ratios. The few pounds of coke saved always mean trouble in other directions. As long as the first iron shows from 7 to 10 minutes after the wind is put on, and the iron does not come too slow or hot at the end, it is better not to tamper with the coke ratio of the cupola in question. Similarly to attempt to save 25 cents a ton in the mixture, and increase the percentage of discards or the cost of machining is a waste. Buying high silicon iron to mix with plow points may work all right, but usually means waste until handled right. Far better, if hard and soft irons are to be made in a day's run, to use high grade ferro-silicon in the ladle.

The above thoughts are but a few that come up in connection with waste in the foundry. It is up to every foundryman to study his problem carefully, working hand in hand with his foreman, and making change after change after careful deliberation. Eternal vigilance is the price of financial success, and with safeguards placed about every process used, details put into responsible and intelligent hands, the supervision of a plant becomes a pleasure instead of a burden.

Waste of Natural Resources.

With the frightful waste of our natural resources going on, it is only a question of time when we will be confronted with scarcity of good fuels, iron, lumber, and many other materials entering into the economy of a manufacturing establishment. At least, therefore, let us take care of our end of the problem. Let us learn how to use inferior materials and still get success by improving our processes. Last year as between the by-product coke oven and beehive, over $20,000,000 went up into the air as smoke and gas. We are cutting down our forests at a rate in excess of the annual growth. Only 60 years of anthracite are available, and instead of mixing the magnificent coals of the Connellsville region with the poorer varieties and making serviceable coke besides making the good material last longer, we are sending a good percentage up in smoke.

In these times of industrial depression let us put on our thinking caps and take stock of the situation. With the good example of our industrial associations established solely for educational purposes, our technical schools which are doing splendid work along the same lines, and an awakening understanding of the importance of making every pound of ore count, we should look into a bright future for this great nation.

The work of the Winona Technical school was briefly described by Mr. Johnson and was illustrated by stereopticon views, Vocal selections by the Institute Glee Club were interspersed between the addresses. Preceding the meeting an informal dinner was tendered Dr. Moldenke in the dining room of the institute.

Exhibits.

The exhibits were located on three floors of the Engineering building. The molding machines were gathered in the foundry where molds were made and a heat was cast on Friday. Frequent demonstrations of the action of thermit were also made. Core room equipment and pattern shop machines were exhibited on the second floor and pneumatic rammers, hoists and sand shakers were shown in the basement.

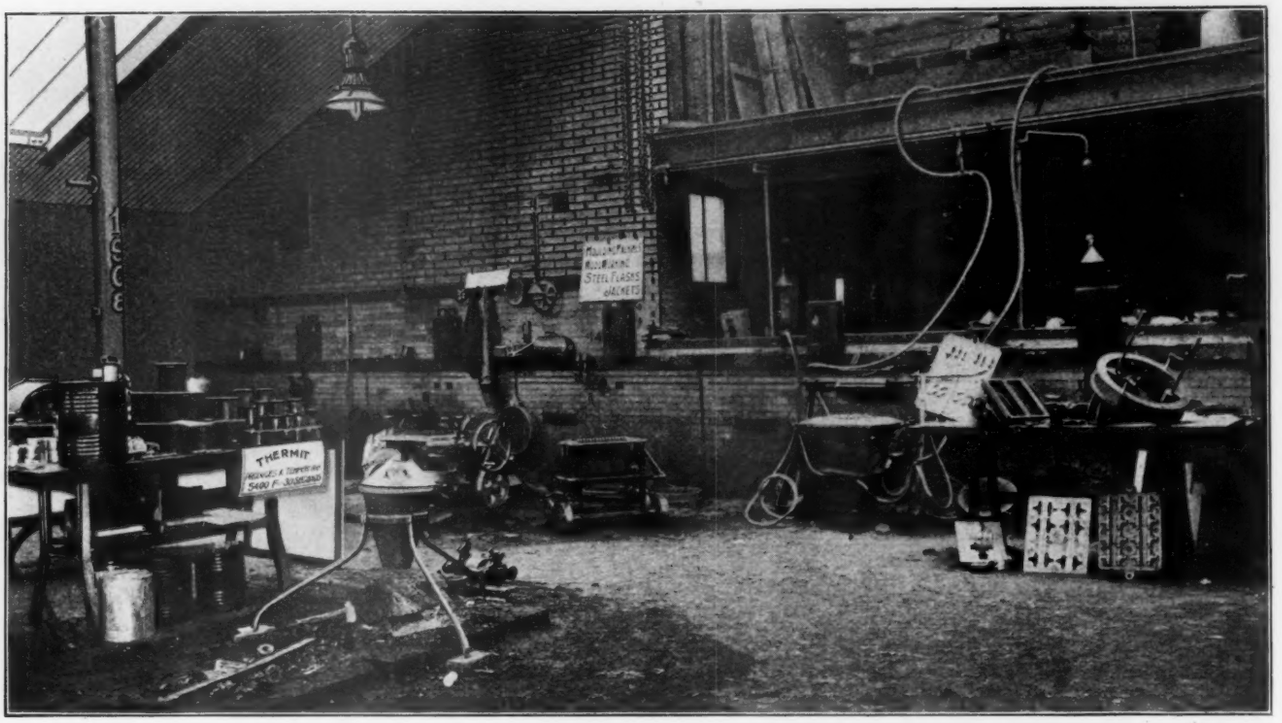
Exhibits of supplies and equipment were made by the following concerns:

Arcade Mfg. Co., Freeport, Ill.—The "Modern" molding machine.

Brand, S. H., Co., Chicago.—Core machine for making cores from ¼ to 5 inches.

Brown Specialty Machinery Co., Chicago.—Hammer core machine.

Calumet Engineering Works, Harvey, Ill.—This concern exhibited drawings and photographs



EXHIBITS OF FOUNDRY EQUIPMENT AT THE LEWIS INSTITUTE

GOLDSCHMIDT THERMIT CO. KILLING MOLDING MACHINE CO. E. H. MUMFORD CO.

of a new cupola that attracted considerable attention.

Chicago Pneumatic Tool Co., Chicago.—Pneumatic tools, rammers, chippers, etc., and electric hoists.

Falls Rivet & Machine Co., Cuyahoga Falls, O.—Core cutting-off and coning machine; core machines and core oven.

Fox Machine Co., Grand Rapids, Mich.—Complete line of pattern shop machinery, including Universal trimmers and the Thomes core box machine.

Garden City Sand Co., Chicago.—Molding sand, core sand, cupola blocks, fire brick and fire clay.

Goldschmidt Thermit Co., New York.—Practical demonstrations of the use of thermit were made daily in the foundry.

Hanna Engineering Works, Chicago.—Pneumatic and electric shakers, electric rotary riddle.

Ingersoll-Rand Co., New York.—Pneumatic chippers, rammers, drills and air hoists.

Killing Molding Machine Co., Davenport, Ia.—Roll-over molding machine; motor-driven universal saw table.

Kroeschell Bros. Co., Chicago.—Kroeschell-Schwartz gyrating flame crucible furnace for melting brass and crucible steel.

Macphail Flask & Machine Co., Chicago.—Self-releasing steel flasks.

Mumford, E. H., Co., Philadelphia.—Split pattern power ramming molding machine. The French cliche pattern process was also shown.

Norton Co. and the Norton Grinding Co., Chicago.—Full line of grinding wheels.

Obermayer, S., Co, Cincinnati.—Kantbebeat Core Compound, S. O. Core Binder, and a core oven for small cores. Cores, made with this compound and binder were baked at this exhibit.

Paxson, J. W., Co., Philadelphia.—Complete line of foundry brushes, riddles, and other foundry supplies.

Pridmore, Henry E., Chicago.—Square stand machine fitted up for molding gears; single stand rock-over machine fitted with an oven door pattern, the cope being made on the stand; rock-over drop machine, 16 x 14 inches, fitted up for molding pulleys; stripping plate machines fitted up for truck wheels and pulleys.

Sandwich Mfg. Co., Sandwich, Ill.—Molding machine for light work.

Tabor Mfg. Co., Philadelphia.—Power roll-over molding machine. On this machine was mounted a 45 x 28 x 9-inch flask with an assortment of patterns on the pattern plate. The flask weighed 650 pounds, although the machine has a capacity for rolling over flasks up to 1,000 pounds. The Tabor light power squeezer was also shown.

Toles, W. C., Chicago.—Patternmakers' vises.

The Lewis Institute.

The Lewis Institute, where the exhibit was held, was opened in 1896, and owes its existence to Allen C. Lewis, who died in 1877, leaving an estate valued at $600,000. The founder of the institute desired to assist "those who are in need of an education, and who are so circumstanced as to be unable without aid to obtain the instruction in arts and sciences that their advancement in life requires."

The Institute is a school of engineering for men and domestic economy for women. Its purpose is to provide such technical training as underlies a large number of vocations in which skill and trained intelligence are demanded. It aims to raise the worker's scale of wages, to improve his standard of living, and to enlarge his field of usefulness, by placing within his reach opportunities for advancement suited to his capacity and his needs.

The policy of the institute has been from the first to adjust the relations of school and pupil that no deserving person is deprived of an education through inability to pay the tuition. A majority of the students are in whole or in part self-supporting.

The work of the institute is of three grades; that of the academy, the evening school, and the college, and in each grade, general and technical subjects are taught.

The institute welcomes any person to any course that he can profit by. A student may attend in the evening for two hours, or four hours a week; in the daytime for 5 hours a week, or 10, or 20, or 30, or 40. When a student applies for admission, he, and his parents, in the case of a minor, are given to understand that his application is first of all a business proposition. Is he prepared to profit by the instruction that is given? Can the institute afford to invest in him? In making such an investment, is it putting to good use the income of the funds provided by its founder? It is assumed that if the candidate for admission makes reasonable advancement in his studies and does not interfere seriously with the best interests of his associates the investment is a good one. The contract is such that it may be terminated at any time by either party.

It was the design of the founder that the Lewis Institute should meet the needs of three classes of students: (1) those who can give their entire time to study until a prescribed course is completed; (2) those who are obliged to earn their living or to do

something toward earning a living when they leave the grammar school; (3) adults who are engaged in occupations in which the highest success depends upon their making up deficiencies of their early education and becoming familiar with the principles underlying the work in which they are engaged.

The Institute confers but one degree, that of mechanical engineer. The first class was graduated in 1901, and the number of graduates, including those of 1907, is 32. The title of associate is given to those who have completed two years of a college course. Including the present year, 1907, the title has been conferred upon 103 men and 188 women.

Nowhere has the plan of the founder been carried out more faithfully then in the evening school. There are well-attended classes in English, mathematics, and one or more commercial subjects, but the greater part of the work is in science and engineering. Men and women who are employed during the day select those subjects which increase their efficiency or appeal to their personal tastes. The drafting rooms, shops, and laboratories in science and engineering afford ample opportunities to the machinist, who wishes to fit himself for work upon another machine, to the clerk who expects some day to be an electrician, or the bookkeeper who aspires to the position of an expert chemist.

The income of the institute is derived from two sources, the fees of the students and a productive endowment of $1,000,000. About 40 per cent of the amount paid for instruction and maintenance is obtained from the endowment. Tuition fees are not large. For students in the day classes they vary from $20 to $30 for a term of 12 weeks; students in the evening classes pay from $5 to $10 for a term of 10 weeks. A system of scholarships and student service is of great help to deserving young persons, some of whom find it possible to pay the entire expenses of living and secure an education as well.

FOUNDRYMEN'S MEETING AT TORONTO

An Elaborate Entertainment Program Has Been Outlined by the Canadian Committee

MANUFACTURERS of foundry supplies and equipment are already manifesting considerable interest in the exposition of foundry appliances to be held in Toronto the second week in June, concurrent with the annual meeting of the American Foundrymen's Association and allied organizations. Considerable space has already been allotted and applications from prospective exhibitors are being daily received.

The Canadian foundrymen are making elaborate preparations for the entertainment of the visitors and have appointed the following chairmen of the various committees that will have charge of the convention: Entertainment, Fred Somerville, Somerville, Ltd., Toronto; finance, Peter McMichael, Dominion Radiator Co., Toronto; Press, W. W. Near, Page-Hersey Co., Guelph; grounds and buildings, Robert Cluff, King Radiator Co., Toronto.

Among the entertainment features suggested, though not officially acted upon, are a moonlight ride on Lake Ontario, a smoker and an official reception by the civic authorities.

No better place for holding the convention with a view to the comfort and enjoyment of the delegates could have been secured than the Industrial Exhibition buildings, which are pleasantly situated in Exhibition park about two miles from the business center of the city. The park, which is located on the lake shore, with a beautiful view, is of historic interest as included within its area of nearly 200 acres is the site of Fort Rouille, the old trading post established in 1749 under the French regime. The exhibition

MACHINERY HALL, TORONTO EXHIBITION PARK, WHERE FOUNDRY EQUIPMENT WILL BE EXHIBITED

PROCESS BUILDING, TORONTO EXHIBITION PARK, WHICH WILL ALSO CONTAIN EXHIBITS OF FOUNDRY EQUIPMENT

buildings cover nearly 30 acres, and the annual exhibition held early in the fall attracts visitors from all parts of the continent. The Dairy building in which the convention will meet has floor space amounting to 25,000 square feet and an auditorium with a seating capacity for 1,500.

Machinery hall, which has been set apart for the exhibits of the Foundry Supply Association, has 35,000 square feet of floor space, and the Process building, which is also available, if required, has 86,000 square feet of floor space. Here, during fair time, the processes of 30 factories have been simultaneously shown in operation with every necessary facility provided.

Though it will not be brought into requisition on this occasion it is worth noting that the grand stand on the grounds, with its seating capacity for 16,400 persons, is believed to be the largest in the world and that every pains has been taken to render it absolutely fireproof.

The grounds in the vicinity of the buildings are shaded with fine ornamental trees with well-kept flower beds at intervals, and the breezes from the lake render it pleasantly cool in summer.

Meeting of the Supply Association Executive Committee.

A meeting of the executive committee of the Foundry Supply Association was held in the King Edward hotel, Toronto, March 2 and 3. The following members were present:

E. H. Mumford, W. S. Quigley, J. S. McCormick, F. N. Perkins, U. E. Kanavel, J. S. Smith, E. J. Woodison, George Rayner, H. M. Lane. Mr. Somerville, chairman of the reception committee, L. L. Anthes, vice president of the American Foundrymen's Association, who has charge of the entertainment to be provided at Toronto, together with several members of the Manufacturers' Association and others interested in the success of the convention and exhibit, were also present to assist in the planning for that event. The fine large exhibit buildings were inspected and all of the members were much pleased with the facilities furnished.

Two new applications for membership were received during the meeting, making a total of six new members within a week. A considerable number of applications have also been received thus early for exhibit space, both in the power section and in the Process building. These matters were reported and discussed at the meeting. Mr. De Clercy, of Montreal, presented his application for membership and offered to exhibit one of his French cupolas in operation so as to furnish molding machine exhibitors with iron for pouring molds. This is the first time that the association has had melted iron available at a convention.

Cost of Space.

The space rates this year were fixed as follows: Twenty-five cents per square foot for the first 100 feet, 20 cents per square foot for the second 100 square feet, and 15 cents per square foot for all additional space. This charge includes light and power from shafting where this is necessary.

Special arrangements will be made with firms that desire extra illumination in the way of electric signs or electric display. The building now contains a large number of booths, so that most, if not all, of the exhibitors can be provided at least with railings. The floors are of such a nature that they require no extra flooring laid upon them, as was the case at Philadelphia. This makes it possible to exhibit much more cheaply than heretofore.

Among the rules passed by the committee for the guidance of the secretary for this year are the following:

No exhibits can be received for installation in the buildings until freight and other charges have been paid.

A payment of 25 per cent of the space charge is to be made within 10 days of the time of allotment, and the balance paid not later than 10 days previous to the convention.

No space shall be allotted to a given firm or person until all dues and other accounts due the association from such firm or person shall have been paid in full.

Non-members of the association shall be charged an admission fee of 25 cents to the exhibit, association members being admitted by badge.

The matter of co-operation with the local Toronto entertainment committee was discussed and it was voted to make a definite subscription of $500 to its entertainment fund, and in addition to give the Toronto entertainment committee $40 from the initiation fee and dues of each new member joining the association from Canada and taking part in this year's convention and exhibit.

Reports of Secretary and Treasurer.

The reports of the secretary and treasurer for the past year were then read and approved. The secretary was asked to form a budget of probable expenses for the convention and to submit the same to the president. In the secretary's

report he stated that there were 106 applications for membership received previous to the Philadelphia convention. Of this number three withdrew previous to the convention and did not exhibit or attend. Two other companies have gone out of business since, and a third has transferred its foundry supply business to another concern, so that the net active membership on Feb. 1 was 100 members. As already mentioned, six applications for membership have been received since that date.

The fact that the books were not audited and the accounts balanced until nearly nine months after the last convention has necessitated including in the report a large portion of the expense incurred in preparing for the coming convention. Notwithstanding this fact, the accounts show a substantial balance in the treasury and the affairs of the association are in excellent condition.

American Brass Founders' Association.

Concurrent with the convention of the American Foundrymen's Association, the American Brass Founders' Association will hold its first annual meeting in Toronto. Andrew M. Fairlie, secretary, P. O. Box 197, McCays, Tenn., has issued a circular to the members of this society, announcing the meeting, and suggests that those intending to contribute papers should send their manuscript to him on or before May 1. The following have recently been elected to membership in this organization: David Hunt Jr., Cleveland; Edmund A. Marriam, Torrington, Conn.; Pittsburg Brass Mfg. Co., Pittsburg, Pa.; Hazard, Coates & Bennett Co., Rochester, N. Y.; H. B. Sherman, Battle Creek, Mich.; E. H. Mumford, Philadelphia; Davis Price Foundry & Machine Co., New Cumberland, W. Va.; Tampa Foundry & Machine Co., Tampa, Fla.; F. A. Coleman, Cleveland; Jas. Morrison Brass Mfg. Co., Toronto, Can.

A PRACTICAL PATTERN SHOP SYSTEM

A Simple Method of Recording Patterns—The Use of Distinctive Colors

BY OSCAR E. PERRIGO

A PATTERN shop system, in common with every other system, should be practical to be useful or worthy of consideration in a commercial sense. It is comparatively easy to construct theoretical systems that look well on paper, and that really appear to bristle with brilliant and original ideas that stand as shining marks of the technical ability of their author. They look well on paper, but when they are brought up against the hard usage of everyday practice the gilt is liable to rub off and they look very crude in spots. One by one the brilliant features are dropped and plain everyday ideas take their place until there is little left of their former luster.

We want system but not red tape. We don't care so much for something brilliant and original as we do for something practical and workable. Something that will not cost more to administer than the facts it determines and records are worth; a system for the shop that shop men can learn and practice, and still have time left to devote to their legitimate shop work. Therefore, while we want system, we want simplicity, and just plain everyday common sense applied to shop conditions.

Objects of the System.

It is with this point in view that the following system is presented for use in the pattern shop. Portions of it are original with the writer so far as he knows. Some parts have been used by others. The entire system has been successfully used under the supervision of the writer and was appreciated by the men who had to use it and were guided by it.

Purpose of the System.

The principal objects sought to be accomplished by this system are:

First—To avoid mistakes in materials by the use of distinctive and appropriate colors for patterns, blanks, record cards, etc.

Second—To simplify the designation of machines by the use of a single letter; of patterns by the use of a series of numbers for each machine, and to designate like parts in different machines by the same number.

Third—To mark patterns that they will indicate the changes that have been made on them.

Fourth—To mark patterns to indicate the date of the changes made.

Fifth—To know immediately the location of any pattern that may be required.

Sixth—To know immediately what castings have been ordered, those received, their weights, and those that have not yet been received.

Seventh—To provide a method by which the molders and cleaning room men may check the number of pieces of each part as they are molded or cleaned.

These conditions are met in a simple and practical manner, economical and easy for the workmen to memorize and carry out.

The machine shop in which this system was organized did a variety of work. Several general classes of machines were regularly built and a number of sizes of machines of each class. There was a well equipped pattern shop from which was turned out patterns for gray iron, malleable iron, steel castings, brass, bronze and aluminum. All these castings were ordered from other concerns, the shop having no foundry of its own. These several foundries were located from a few blocks to hundreds of miles away.

There was constant trouble and annoyance as well as delay and loss on account of patterns being sent to the wrong foundry, and parts that should be of brass were made of malleable iron; those that were intended to be of steel castings were made of gray iron, and so on.

The writer took charge of this concern. The losses caused by paying for castings of the wrong metal and delays in getting out work were enlarged upon. It was proposed to have printed labels attached to each and every pattern with the name of the metal of which it was to be cast, in plain letters. The writer disagreed with this and a number of similar propositions because he had seen them tried and fail.

Human nature is much the same everywhere and printed labels and directions usually fail to impress the

PATTERN CARD

PART Cylinder NO. 15

MACHINE 8×12" Horizontal Engine SYMBOL A

MADE May 15 1906 BY Albert L. Brown

CHANGES

DATE	HOW CHANGED
Sept 3.06	Head Flanges thickened 1/8"

The Foundry

FIG. 1—CARD FOR INDEXING PATTERN, 3 x 5 INCHES

average shop or foundryman. At the same time a *distinctive color* appeals to the man at once. With this idea in mind the material of which a piece was to be cast was indicated by the *color* of the pattern.

All core prints were painted red, without regard to the material from which the piece was to be cast. The bodies of the patterns were made black for gray iron; brown for malleable iron; blue for steel castings; yellow for brass; orange for bronze, and lead color for aluminum castings. The interior forms of cores was indicated by red dotted lines about ⅛ of an inch wide on both the outside and on the inside of a dividend or split pattern. The writer followed up the record of this work for nearly 14 years and no instance was reported of a pattern going to the wrong foundry.

The coloring of the patterns is a simple matter. Dry colors are purchased as follows: Lampblack, American vermillion, ultramarine blue, burnt umber, chrome yellow and white lead. The colored varnish is made by mixing a sufficient quantity of the dry color to a paste with clear alcohol; then adding the shellac varnish as usually prepared. The orange color is made by the addition of a small quantity of red to the prepared yellow varnish for brass. The lead color is made by first mixing the dry white lead as above and adding a very small quantity of black shellac varnish.

With the exception of the vermillion, the colors are all quite cheap, so that the question of expense is of little importance.

System of Numbering Patterns.

There have been a good many different systems proposed for numbering and recording patterns. All of these have some good points, but most of them contain weak or undesirable features.

In a general way the different systems used for the purpose of marking and identifying patterns may be divided into three classes, as follows:

First—The use of serial numbers only without regard to the purpose of the pattern, the machine to which it belongs, or the metal of which the part is to be cast. For instance, the marking would be 25438.

Second—The use of serial numbers as in the first class, to which is prefixed a machine symbol composed of letters or figures, or a combination of both, as for instance—2B-25438.

Third—The use of machine numbers, that is a series of numbers for each machine, to which is prefixed a machine symbol composed of letters or figures, or a combination of both, thus B 25.

The objection to the first system is, that it is an indiscriminate mass of figures, some one of several thousand combinations of which will mean the particular pattern we may want to find. The fact that we know the name of the pattern, that we know what machine it is used upon and just what the office of the piece is in the machine, does not help us. We must search a card or book record and find the list of patterns for this particular machine; then search the list for this particular part; here we find the serial number consisting of anywhere from one to six figures. The search consumes too much time.

The second objection is that there are often too many figures used on the pattern. It is well to have the distinguishing mark on a pattern as simple and of as few characters as possible, for reasons of economy in attaching them to the pattern, and that the more simple they are the less liability there will be for mistakes.

LIST OF CASTINGS

FOR 8×12 Hor. Engine SYMBOL A

LIST COMPILED July 21 1906

GREY IRON CASTINGS

PART NO.	PART NAME	NO. EACH MACHINE	WEIGHT EACH

The Foundry

FIG. 3—STANDARD LIST OF CASTINGS

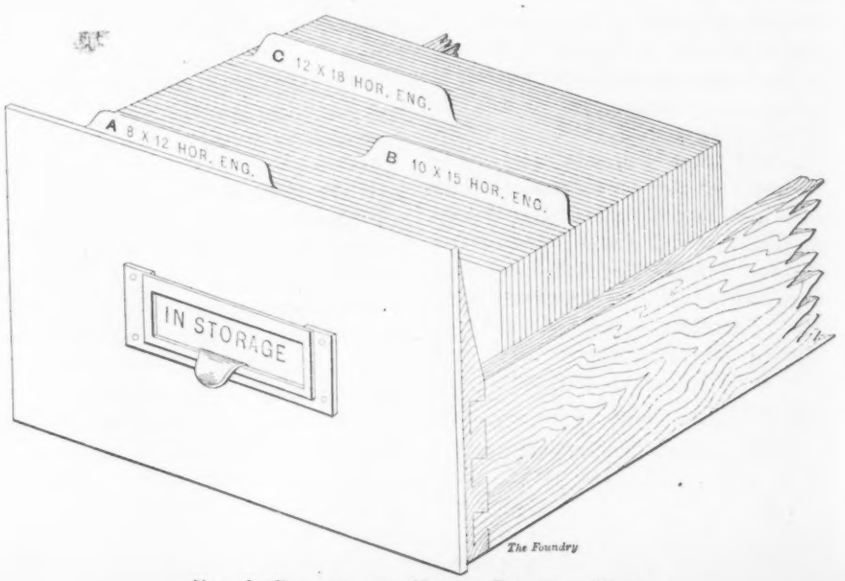


FIG. 2—DRAWER FOR FILING PATTERN CARDS

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

Standard Specifications for Cast Iron Car Wheels.
(Continued from Data Sheet No. 14.)

Thermal Test.

12. The other two test wheels must be tested as follows: The wheels must be laid flange down in the sand, and a channelway one and one-half inches in width at the center of the tread and four inches deep must be molded with green sand around the wheel. The clean tread of the wheel must form one side of this channelway, and the clean flange must form as much of the bottom as its width will cover. The channelway must then be filled to the top from one ladle with molten cast iron, which must be poured directly into the channelway without previous cooling or stirring, and this iron must be so hot, when poured, that the ring which is formed when the metal is cold shall be solid or free from wrinkles or layers. Iron at this temperature will usually cut a hole at the point of impact with the flange. In order to avoid spitting during the pouring, the tread and inside of the flange during the thermal test should be covered with a coat of shellac; wheels which are wet or which have been exposed to snow or frost may be warmed sufficiently to dry them or remove the frost before testing, but under no circumstances must the thermal test be applied to a wheel that in any part feels warm to the hand. The time when pouring ceases must be noted, and two minutes later an examination of the wheel under test must be made. If the wheel is found broken in pieces, or if any crack in the plates extends through or into the tread, the test wheel will be regarded as having failed. If both wheels stand, the whole hundred will be accepted as to this test. If both fail, the whole hundred will be rejected. If one only of the thermal test wheels fails, all of the lot under test of the same shrinkage or stencil number will be rejected, and the test will be regarded as finished, so far as this lot of wheels is concerned. The manufacturer may, however, offer the wheels of the other two shrinkage or stencil numbers, provided they are acceptable in other respects, as constituents of another 103 wheels for a subsequent test.

Storing and Shipping.

13. All wheels which pass inspection and test will be regarded as accepted, and may be either shipped or stored for future shipment, as arranged. It is desired that shipments should be, as far as possible, in lots of 100 wheels. In all cases the Inspector must witness the shipment, and he must give, in his report, the numbers of all wheels inspected and the disposition made of them.

Rejections.

14. Individual wheels will be considered to have failed and will not be accepted or further considered, which,

First. Do not conform to standard design and measurement.

Second. Are under or over weight.

Third. Have the physical defects described in Section 6.

15. Each 103 wheels submitted for test will be considered to have failed and will not be accepted or considered further, if,

First. The test wheels do not conform to Section 7, especially as to limits of white iron in the throat and tread and around chaplets.

Second. One of the test wheels does not stand the drop test as described in Section 11.

Third. Both of the two test wheels do not stand the thermal test as described in Section 12.

STANDARD SPECIFICATIONS FOR LOCOMOTIVE CYLINDERS.*

PROCESS OF MANUFACTURE.

Locomotive cylinders shall be made from good quality of close-grained gray iron cast in a dry sand mold.

CHEMICAL PROPERTIES.

Drillings taken from test pieces cast as hereafter mentioned shall conform to the following limits in chemical composition:

Silicon	from 1.25 to 1.75 per cent.
Phosphorus	not over 0.90 " "
Sulphur	" " 0.10 " "

PHYSICAL PROPERTIES.

The minimum physical qualities for cylinder iron shall be as follows:

The "Arbitration Test Bar," 1¼ inches in diameter, with supports 12 inches apart, shall have a transverse strength not less than 3,000 pounds, centrally applied, and a deflection not less than 0.10 of an inch.

TEST PIECES AND METHOD OF TESTING.

The standard test shall be 1¼ inches in diameter, about 14 inches long, cast on end in dry sand. The drillings for analysis shall be taken from this test piece, but in case of rejection the manufacturer shall have option of analyzing drillings from the bore of the cylinder, upon which analysis the acceptance or rejection of the cylinder shall be based.

One test piece for each cylinder shall be required.

CHARACTER OF CASTINGS.

Castings shall be smooth, well cleaned, free from blowholes, shrinkage cracks or other defects, and must finish to blue-print size.

Each cylinder shall have cast on each side of saddle manufacturer's mark, serial number, date made and mark showing order number.

INSPECTOR.

The inspector representing the purchaser shall have all reasonable facilities afforded to him by the manufacturer to satisfy himself that the finished material is furnished in accordance with these specifications. All tests and inspections shall be made at the place of the manufacturer.

*Adopted by the American Society for Testing Materials.

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

The second plan is an improvement on the first, and its adoption was the result of a realization of the defects enumerated above. The addition of a machine symbol at least locates the pattern as belonging to a certain machine.

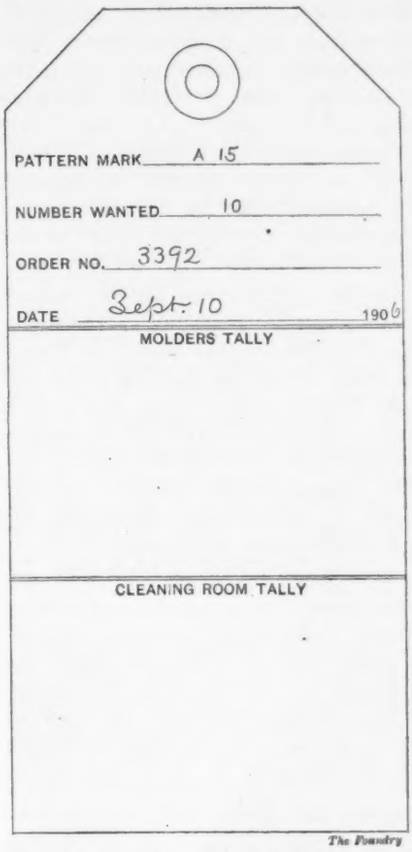


FIG. 5—TALLY CARD FOR MOLDERS AND CLEANING ROOM MEN

In the third plan the shortcomings of both of the former plans are corrected, and while the number of characters necessary to properly designate the pattern is reduced, it will be much easier to locate the pattern by the record, or its place in the record if we have the pattern.

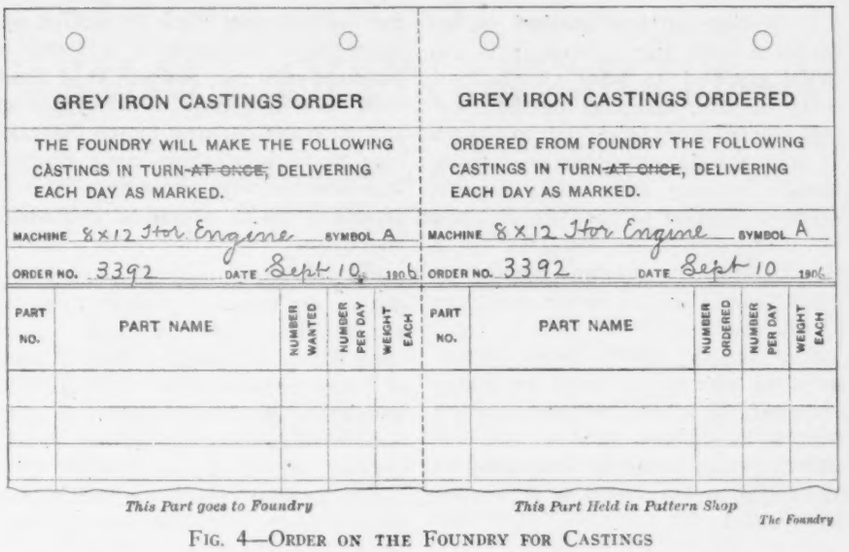

GREY IRON CASTINGS ORDER
THE FOUNDRY WILL MAKE THE FOLLOWING CASTINGS IN TURN ~~AT ONCE~~, DELIVERING EACH DAY AS MARKED.
MACHINE 8 X 12 Hor. Engine SYMBOL A
ORDER NO. 3392 DATE Sept. 10 1906
PART NO. | PART NAME | NUMBER WANTED | NUMBER PER DAY | WEIGHT EACH
This Part goes to Foundry
GREY IRON CASTINGS ORDERED
ORDERED FROM FOUNDRY THE FOLLOWING CASTINGS IN TURN ~~AT ONCE~~, DELIVERING EACH DAY AS MARKED.
MACHINE 8 X 12 Hor. Engine SYMBOL A
ORDER NO. 3392 DATE Sept. 10 1906
PART NO. | PART NAME | NUMBER ORDERED | NUMBER PER DAY | WEIGHT EACH
This Part Held in Pattern Shop
The Foundry

FIG. 4—ORDER ON THE FOUNDRY FOR CASTINGS

Details of the System.

Having arrived at this conclusion the details of the system will be described. Suppose, for instance, there are several general classes or types of machines built and in each class several sizes. Each machine would be designated by a single letter. The patterns for each machine would be numbered serially, taking the base, or largest cast iron part as number 1, and continuing the numbers through its related parts. Then leaving several blank numbers to apply to parts that might be added to the machine later. The next group of related parts would be taken up in the same manner until all the cast iron parts were listed, leaving blank numbers at the end of each group of related parts.

Having finished with the cast iron parts, those of other material such as steel castings, malleable iron, brass, bronze, etc., would be listed in the same manner, leaving blank numbers after the parts of each kind of metal.

Similar pieces of all machines of the same class would have like numbers. For instance, if engines were built and the cylinder was marked 15, all cylinders would be number 15, the letter indicating the size, showing the engine to which it belonged. Thus, if A indicated a 8 x 12 engine, A15 would be its cylinder pattern, and B15 might be the cylinder of a 10 x 15 engine, and so on.

Not only will these letters as machine symbols, but the pattern numbers be easily memorized in a short time by the men handling patterns and castings, while the serial numbers, as 25438, are meaningless without a complete list of all the patterns.

By this system the numbers will be confined to three figures and ordinarily one-third or one-half will be represented by two figures only.

Another feature of this system is the ease with which alterations of the pattern are also indicated. For instance, if pattern B15 has been changed, a hyphen added will indicate the fact, thus B15-. If it is desired to give the year when the change was made the mark will appear thus, B15-06. Even the month during which the change was made may be indicated thus, B15-5-06, making it read "cylinder for 10 x 15-inch engine, changed May, 1906." Subsequent changes may be indicated in a similar manner.

If a pattern answers for two sizes of machines the symbol of both machines are shown thus, AB25.

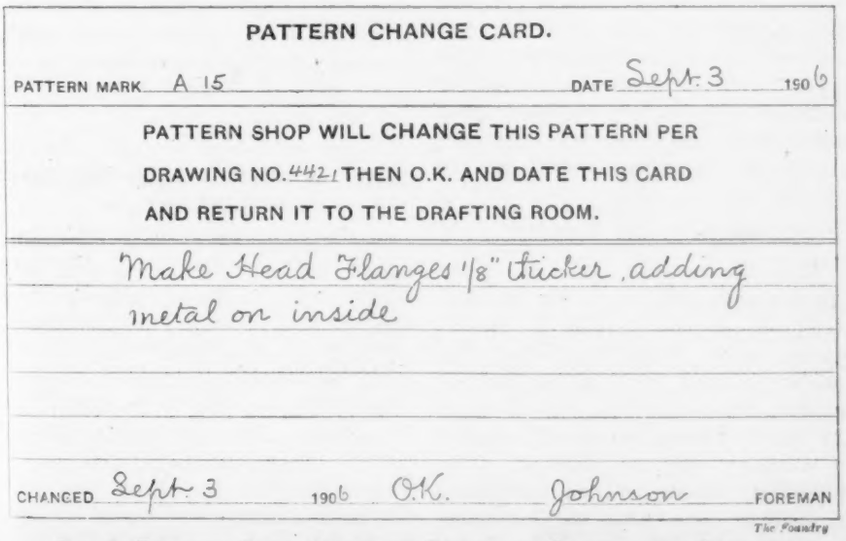

PATTERN CHANGE CARD.
PATTERN MARK A 15 DATE Sept. 3 1906
PATTERN SHOP WILL CHANGE THIS PATTERN PER DRAWING NO. 4421 THEN O.K. AND DATE THIS CARD AND RETURN IT TO THE DRAFTING ROOM.
Make Head Flanges 1/8" thicker, adding metal on inside
CHANGED Sept. 3 1906 O.K. Johnson FOREMAN
The Foundry

FIG. 6—DRAFTING ROOM ORDER FOR CHANGE OF PATTERN, 3 x 5 INCHES

In storing patterns marked in accordance with this system it is entirely practical to keep all the patterns of one machine together, except some very large patterns such as engine beds, etc., that are readily found in any case. The alcove, space, or section of shelving occupied by them should be indicated by a sign bearing the machine symbol or letter, and also the name and size of the machine.

This system applies more particularly, of course, to shops producing machines, or sets of machines, rather than to a jobbing shop or foundry wherein the patterns belonging to many customers, as well as their own, are handled.

Recording and Handling Patterns.

As each pattern is finished and numbered, a filing card, 3 x 5 inches is made as shown in Fig. 1, and of a color to indicate the material of which the piece is to be cast. If the piece is to be of gray iron, the card will be gray; if of malleable iron, brown; steel casting, blue; brass, yellow; bronze, orange; aluminum, lead color, or a similar tint that will not be mistaken for the gray card indicating gray iron castings.

These cards are filed in the usual card drawer, according to guide cards indicating the machine to which they belong, as shown in Fig. 2, and in each of these sections numerically, the lowest number nearest the front.

When the pattern is in the pattern storage room the pattern cards are in the drawer labeled on its front, "in storage." When the pattern represented is sent to the foundry the card is transferred to a drawer labeled "in foundry," and should the pattern be brought to the pattern shop for change or repair its card will be placed in a drawer labeled "in pattern shop." Similar changes of the location of cards will be made at every change of location of the pattern. Thus its location is easily kept track of and indicated without making a written entry.

Ordering, Receiving and Inspecting Castings.

In a manufacturing concern of moderate capacity the castings are frequently ordered by, or through the foreman of the pattern shop, who has charge of the patterns in storage and under whose charge the castings are received, inspected, checked and weighed. While it is theoretically proper for the order clerk to order all materials, castings included, and for the receiving clerk to receive and receipt for the same, it is found in practice that the pattern shop foreman, having charge of the patterns and naturally desiring to see the castings made from them come through satisfactorily, will render very efficient service if put in charge of the whole matter.

For use by the superintendent, cost clerk, draftsmen, foundry foreman, pattern shop foreman, and others there should be complete lists of parts of every machine built. In Fig. 3, is shown the heading of a list of gray iron castings which is a part of the general list of parts. These lists should be kept in a loose leaf binder, holding them preferably at the top, which is left sufficiently long and is perforated for that purpose, or at the left side as in an ordinary book.

This list is referred to in making out the order for castings wanted, which should be made in duplicate and of a form similar to that shown in Fig. 4. The original is sent to the foundry together with the patterns, and the duplicate held by the pattern shop foreman for the purpose of checking off the receipt and entering the weights of castings as they come from the foundry. They are filed in a binder for future reference. These sheets are 8½ x 11 inches, are of the same color as the pattern cards, and are perforated through the center.

It will be noted that the words "in turn" and "at once" are printed in the heading. In filling out the order one or the other of these directions are erased according to whether the castings are urgently wanted or not.

These orders are made out for the entire number of castings wanted for a lot of machines ordered at one time, a copy of the original order being sent to the patternmaker as his order. If the castings are wanted for a special job, a copy of the original order, or a foreman's requisition approved by the superintendent will be proper.

Patterns in the Foundry.

When the patterns are sent to the foundry each one has a tag attached to it as shown in Fig. 5, which serves as a "tally card" for the molder to keep track of the number molded, after which it is passed on to the cleaning room where the number of castings may be checked. The difference shown will be those lost in pouring, etc. When the full number is ready and are sent from the cleaning room this tag accompanies them. This is an ordinary manila tag except on an urgent order, when it is red with the word "rush" added at the bottom.

The castings should be inspected for surface defects such as cracks, blow holes, irregularity of surface or form from bad molding, breaks from carelessness in knocking off gates, distortion from irregular shrinkage due to being uncovered too soon after pouring, and similar defects. All castings so rejected should be reported in duplicate, one sheet going to the superintendent and the other to the foundry with the defective castings.

When patterns are to be changed before any more castings are made, a card similar to that shown in Fig. 6 is filled out in the drafting room and sent to the pattern shop where it is filed, the pattern taken from storage, changed, the card dated, marked "O. K.," signed by the foreman and sent back to the drafting room, and the pattern returned to storage.

It will be noted that by this system every transaction is very simple, readily understood and easily performed. There is little opportunity for possible errors. Yet the system furnishes all the facts that are essential to a proper and intelligent conduct of the business.

J .W. PAXSON CO. REORGANIZE.

The J. W. Paxson Co., Philadelphia, has recently elected the following officers: H. M. Bougher, president and general manager; L. B. Shaw, vice president and marine superintendent; Howard Evans, treasurer; J. S. Hibbs, assistant general manager; S. C. Bougher, purchasing agent and secretary; A. G. Warren, consulting engineer. The reorganization was made necessary by the recent death of its president, J. K. Bougher.

SAND WASHING AND SCREENING PLANT.

The Ballou's White Sand Co., Millington, Ill., miner and shipper of high grade white silica sand, magnesia and core sand, is erecting a modern washing and screening plant, and will be ready to commence shipping washed silica sand about May 1. The plant will be equipped with high pressure marine boilers, vacuum pumps, steam pumps, washers, screens and drain bins, and will have a capacity of about 30 tons per hour.

CONVERTER VS. SMALL OPEN-HEARTH—IV

A Discussion of the Disadvantages of the Open-Hearth Furnace for Steel Casting Plants

BY W. M. CARR

THE DISADVANTAGES of the open-hearth practice may be summed up as follows:

(1) It is costly to install unit for unit compared to the converter and it is also costly to repair, but the repairs occur only at long intervals, approximately every five months, so that the burden of repair charges is spread over considerable tonnage.

(2) In comparison with the converter it is very slow as a producer. Under normal conditions and with any size charge the shortest time is about six hours per heat. The converter can blow a heat in one-half hour so that concerning the question of speed the converter holds the ground.

Efficiency as a Melting Unit.

(3) The open-hearth is not very efficient as a melting unit and usually one-half of the time required to make a heat beginning with cold stock is taken up in melting, the balance of the time in refining the charge and getting it into condition to tap. This feature, however, cannot be compared with converter operations because it receives its charge in a molten form from a cupola and it is beyond its purpose or power to melt and treat cold stock. The poor melting qualities of an open-hearth can be materially lessened by delivering to it molten metal directly from a blast furnace or a cupola, but either plan is not always feasible. In other words, it is cheaper to melt pig iron and scrap with solid fuel as in a blast furnace or a cupola, than to use for the purpose a gas or oil flame, the fuel of the open-hearth.

Irregular Operations.

(4) An open-hearth is not suited for irregular production. The highest economy can only be reached in continuous operation. It is costly to make a heat at long intervals, the furnace must be kept warm during the spell of idleness, necessitating a steady consumption of fuel. Two reasons are operative, first, because the furnace cannot be brought to working heat at short notice, second, rapid changes in temperatures tend to rack the brick work and shorten the usefulness of the structure. The latter feature is more serious in large furnaces than in small ones, and in regard to the cost of fuel consumption during periods of idleness it will be a heavier item of cost per ton in small furnaces, but the total consumption will be less. In any case the practice is to take off the gas or oil over week ends to allow incidental patching to be carried on, and even under those conditions the furnace will not suffer greatly with stresses in brick work and, in spite of the great changes in temperatures between times of working and patching, open-hearth furnaces will give long active campaigns, so that the question of harm to the brick work is not so serious as some authorities claim. If the heating up and cooling down between heats, in cases of intervals of idleness longer than producing periods, be gradual and moderate there can be no great objection to the practice. The condition to avoid is rapid heating and cooling. The principal drawback to an open-hearth is the matter of fuel consumption to retain the stored heat when it is not working. If one heat per day is all that can be taken at times from a five-ton furnace, a moderate flame must be kept going between heats but losses of heat can be prevented by mudding up doors and openings about the body of the furnace.

Beginning with a cold furnace, fully lined, the heat should be on at least 10 hours before it can receive a charge. Even then the first heat will be slow and cold. A converter can be heated up during the morning in readiness to blow in the afternoon and like the open-hearth its first heat will not be so hot as succeeding ones, but no matter whether running a converter or an open-hearth, one heat per day would be a poor practice since it is apparent that the costs will be heavy when divided among a few tons. There may be excuses for decreased output at times but as a regular practice it cannot be a success commercially.

Lack of Flexibility.

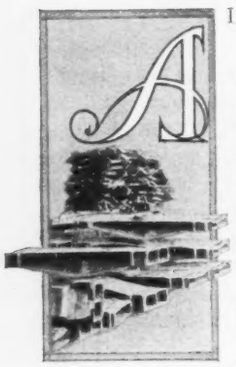
(5) The stationary type of open-hearth lacks flexibility. It is not suited to anything but one grade of steel at a time. It is not easy to split the charge into two or more portions and give each part different doses of ferro-alloys. When a heat is ready to tap all of the metal must be taken out of the furnace. The flow of metal cannot be stopped as in tapping a cupola. With a charge of molten steel in one ladle it becomes complicated and difficult to transfer part of it to another ladle in order to make a variety of compositions. In the case of the converter a blow or heat can be split up into several ladles and each ladle given a different dosing with different ferro-alloys. In this respect the converter enjoys an advantage over the usual type of open-hearth. Were the small open-hearth built of the tilting or rolling type the same possibility to split a heat would be offered as is now enjoyed by the converter. Part of the finished heat could be tapped out into one ladle and by rolling the furnace back the flow of metal could be retarded and then bringing another ladle within reach of the furnace spout the remaining portion of the heat could be partly or wholly discharged. This practice is followed with furnaces of 50 and 100 tons capacity, and there is no reason why the same plan cannot be carried out with smaller furnaces. Such a practice would permit one to fill orders for different varieties of steel castings from one heat in cases where the demand for one class or grade was less than the total capacity of the furnace and in this way meet the recognized flexibility of the converter over the stationary open-hearth.

Results of Open-Hearth Practice.

The writer believes that American metallurgical skill is capable of accomplishing results through the agency of the open-hearth furnace that will bear comparison with any produced in European practice where conditions may be in favor of the converter.

JOBBING STEEL FOUNDRY PRACTICE

Methods Pursued in the New Plant of the Bucyrus Steel Casting Co., Bucyrus, Ohio



ALTHOUGH unlike in equipment and practice, the jobbing steel foundry and the gray iron job shop have much in common. Both must be equipped to produce castings weighing from a few pounds to the limits of their melting capacities, and both light and heavy work must be made with equal facility. Orders for duplicate castings are probably more generally received by the steel foundry, owing to the preference of the railroads for this material, but the molding problems of both are similar owing to the wide range of patterns that are presented from day to day. While many of the gray iron jobbing foundries are inadequately equipped, with a few exceptions, steel casting plants have been designed and constructed to attain minimum operating costs.

In the way of modern equipment there is nothing lacking in the new plant of the Bucyrus Steel Casting Co., Bucyrus, O. Every facility has been provided to expedite operations, and though the first cost of the many labor saving appliances installed would appall the average gray iron founder, nevertheless the reduced cost of manufacture has proven the wisdom of these expenditures.

Building Construction.

The foundry is of brick and steel construction, 350 feet long, 147 feet wide, and has a height of 72 feet to the peak of the middle bay. This provides ample head room underneath the cranes and insures good ventilation. The middle bay is 65 feet wide and has a height of 42 feet to the under side of the crane runway. The side bays are each 42 feet wide and are 26 feet high to the under sides of the crane runways. All of the foundations have been built of concrete, and to insure a greater stability of the curtain walls the bricks have been laid in cement. A windowed monitor, 9 feet high, extends the length of the building and every alternate window can be opened. To provide additional illumination, rows of glass tile have been laid in the roof to a width of 12 feet on either side extending the length of the building. Each tile is 12 x 18 inches, and no less than 5,500 were used. This tile insures a flood of light in the middle bay and even on the darkest days no artificial illumination is required. Rows of windows in the side walls provide ample light for the side bays. Sixteen Crocker-Wheeler mercury vapor lights have been distributed about the foundry and are used only when the plant is operating double turn. The gas producer house, 30 x 70 feet, adjoins the furnace bay of the main building and is equipped with two Forter gas producers installed by the Forter-Miller Engineering Co., Pittsburg.

Arrangement of the Plant.

All of the large, as well as the duplicate work is molded and cast in the middle bay. The open-hearth furnace is located in one of the side bays and the core department, mold drying and core ovens are likewise located in this section. At one end

FIG. 1—COPE AND DRAG OF MOLD CONTAINING 15 PATTERNS

FIG. 2—METHOD OF STACKING MOLDS FOR SMALL DUPLICATE WORK

of the other side bay live patterns are stored, and this section also contains four large stripping plate molding machines, the bench molding department as well as the large annealing pit. A shipping track extends the width of the plant at one end of the building, the cleaning department being located in close proximity. This arrangement eliminates all further handling of castings after they have been cleaned, as they are immediately loaded on to cars by the cranes for shipment.

Steel Flask Equipment.

The equipment of both square and circular cast steel flasks of various sizes is unusually large, and with the exception of very small castings, a pattern of almost any size can be accommodated, insuring the use of a minimum amount of sand in the flask. Small patterns are invariably gated to two or three runners in large flasks,

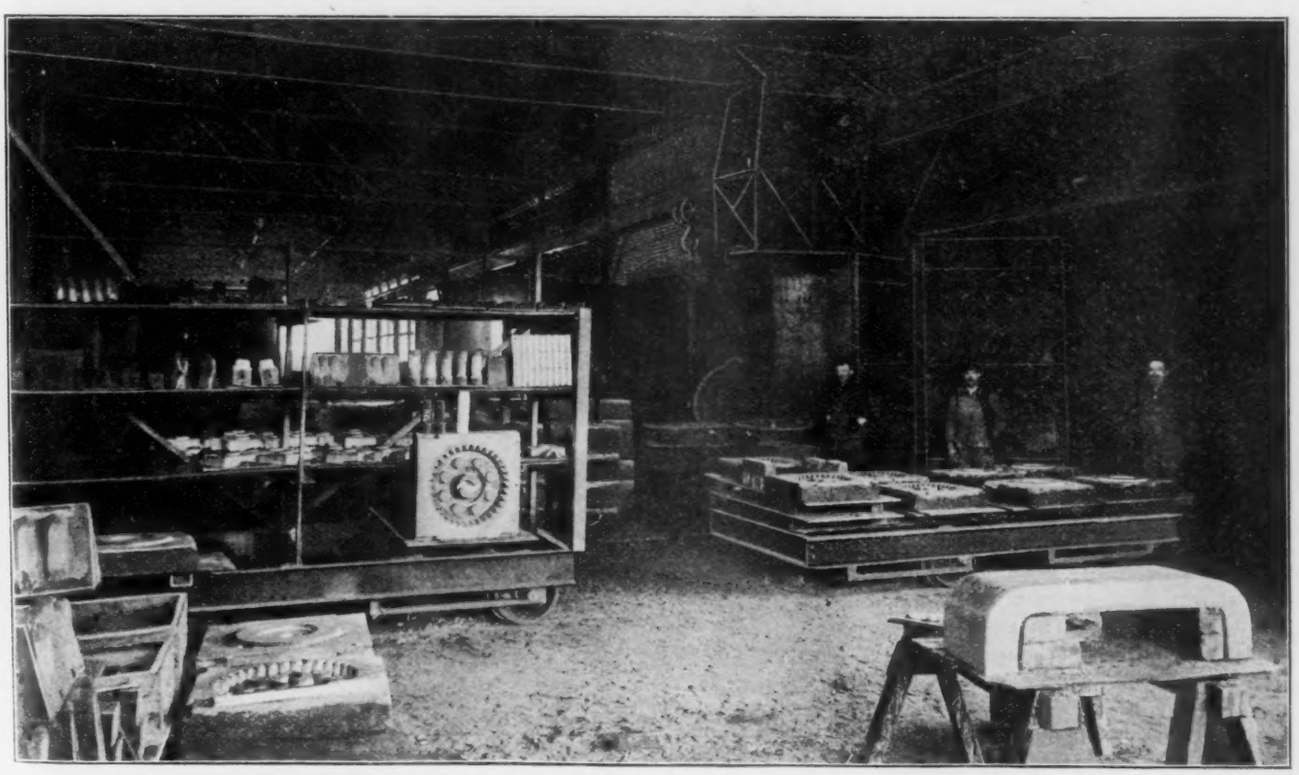


FIG. 3—GEAR MOLDS MADE IN THE CORE DEPARTMENT. THE OVENS AND RACKS ARE ALSO SHOWN

FIG. 4—PAIR OF LARGE STRIPPING PLATE MOLDING MACHINES

as shown in Fig. 1. This is the cope and drag of a mold containing 15 patterns. Seven patterns are gated to one runner and eight to the other. In steel foundries small castings are frequently lost owing to the predominance of large work, but cast on two runners in this way they can be easily followed through the cleaning department. The circular flasks are built in 12 different sizes, from 2½ feet to 12½ feet in diameter, the spread between the sizes being 12 inches. A part of the circular flask equipment is shown in Fig. 7. While not generally used in this country, circular flasks are preferred by many foreign foundrymen in view of the fact that many patterns conform to a flask of this shape, and the amount of sand required is much less than in the square flasks in which the corners carry large bodies of sand that are practically of no value, but nevertheless must be handled.

Stacking Molds.

The molds for duplicate work, such as small gears and pinions, are stacked four to six high. In Fig. 2 are shown four stacks of gear molds piled four high. These molds are made in the core department, cope and drag being shown in the foreground of Fig. 3. A drag of a gear mold is also shown on the core rack, and a number of molds can be seen on the rack entering the oven. By this method of core molding greater accuracy of the castings is assured, which is very essential in the production of gears and similar work. After the molds have been stacked, as shown at the right of Fig. 2, large wooden flasks are placed over them, as shown at the left of this illustration. The stacks are then backed in with sand and clamped as shown. This illustration also shows four castings on two runners as they appeared after they had been shaken out of the sand and before they were cut off their gates.

Core Department.

For drying cores two large ovens 40 x 10 feet each are provided. The racks are fitted with slide bearings that operate on standard gage tracks. Although these ovens are heated with gas at present, they are arranged for coke as fuel, and can be fired from the rear. The ovens are of the downdraft type and contain two natural gas burners, each extending their full length. For drying small cores a portable oven has been installed by the Millett Core Oven Co., Brightwood, Mass. The mold drying oven, 40 x 20 feet, adjoins the core ovens. Standard gage tracks extending across the foundry enter this oven. By this arrangement molds made in any of the three bays can be placed on the racks and delivered directly into the oven without any intermediate handling by the cranes. These racks are equipped with roller bearing trucks and can be operated by one man. The mold drying oven is heated by natural gas, three burners extending its entire length. The oven has also been built

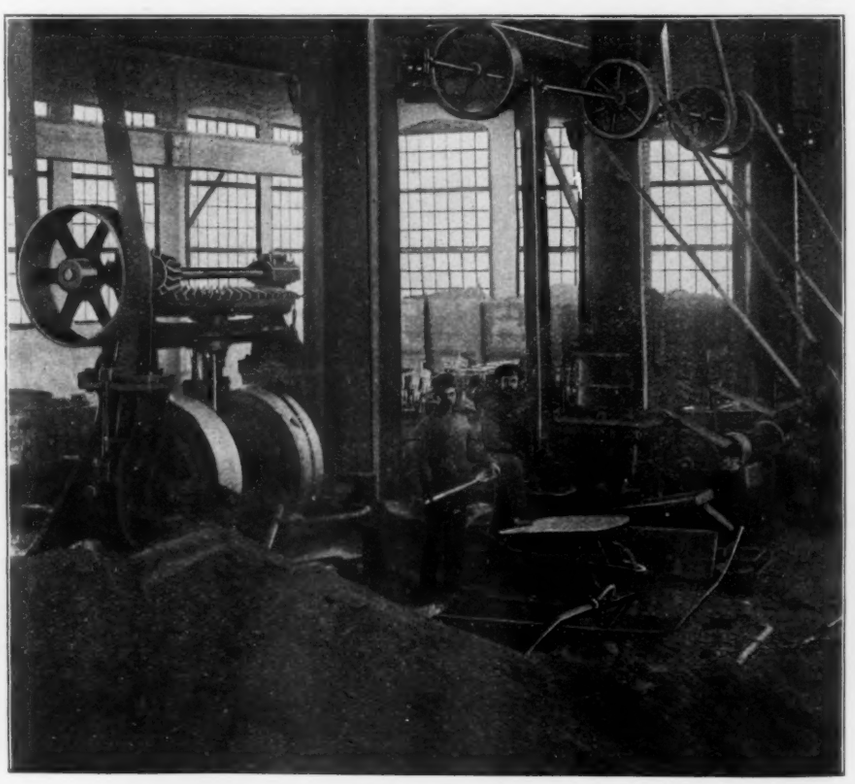


FIG. 5—SAND MILL SHOWING THE BUCKET IN THE PIT

for coke as fuel and is fired from the rear.

Large Molding Machines.

The pattern of a car sill of special design, mounted on a large stripping plate molding machine is shown in Fig. 4. These machines are operated in pairs, the cope being made on one and the drag on the other. Four of these machines are in use. The patterns are dropped away from the molds by hand levers at the sides of the machines. As the flasks containing the sand weigh about 500 pounds each, an overhead crane is utilized for lifting the molds from the machine and rolling them over. All of this and most of the other railroad work, including bolsters, etc., is cast in green sand, dry sand no longer being as generally specified as heretofore.

Traveling Cranes.

The middle bay is commanded by two electric traveling cranes, one of 25 tons capacity having a 10-ton auxiliary hoist, the other of 20 tons capacity. The large crane handles the ladle when pouring off, while the smaller one is used freely by the molders for handling flasks and rolling over their molds. Each of the side bays is provided with a 10-ton crane. The entire equipment was installed by the Niles-Bement-Pond Co., New York.

Sand Mill.

The sand mill shown in Fig. 5 is located in one of the side bays and is equipped with a spout extending in to the middle bay. All of the sand is handled in large buckets by cranes, the sand being delivered to any part of the molding floor in this way. A pit has been provided for the buckets underneath the spout of the mill, and by this arrangement the cost of handling the sand has been greatly reduced. Most of the castings are shaken out of the sand near the mill, which further lessens the handling of this material. Two swinging and three stationary grinders which complete the grinding equipment are also shown in this illustration.

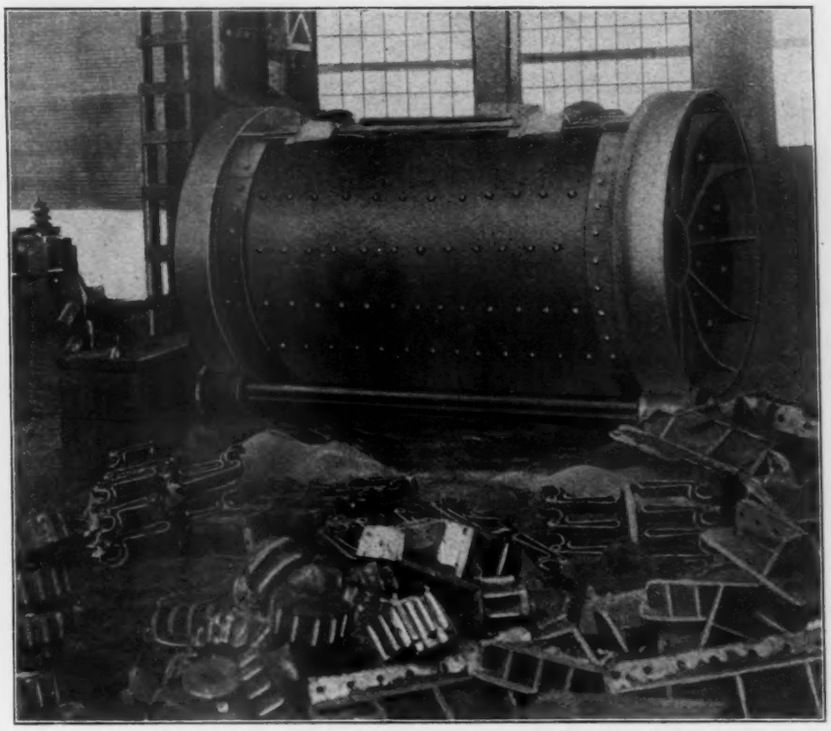


FIG. 6—STEEL PLATE TUMBLING MILL, 10 FEET LONG

FIG. 7—PART OF THE ROUND FLASK EQUIPMENT

Cleaning Department.

For cleaning small castings a large tumbling mill has been built, as shown in Fig. 6. The barrel is mounted on friction drive roller bearings operated by a 25-horsepower motor. After the castings have been cleaned the barrel is lifted from its bearings and carried to the lower end of the foundry by one of the cranes. In the meantime another barrel has been filled and is placed in position by the crane, and while the first barrel is being emptied the castings in the second are being cleaned. A third barrel has also been added to this equipment to insure the continuity of this cleaning operation. The barrels are 10 feet 6 inches long, 5 feet in diameter, and are constructed of ½-inch steel plates, being reinforced inside with removable linings and false heads. The cleaning department also contains one 42-inch Newton cold saw cutting-off machine installed by the Newton Machine Tool Works, Philadelphia, and two 36-inch Q & C cutting-off machines installed by the Quincy, Manchester, Sargent Co., New York.

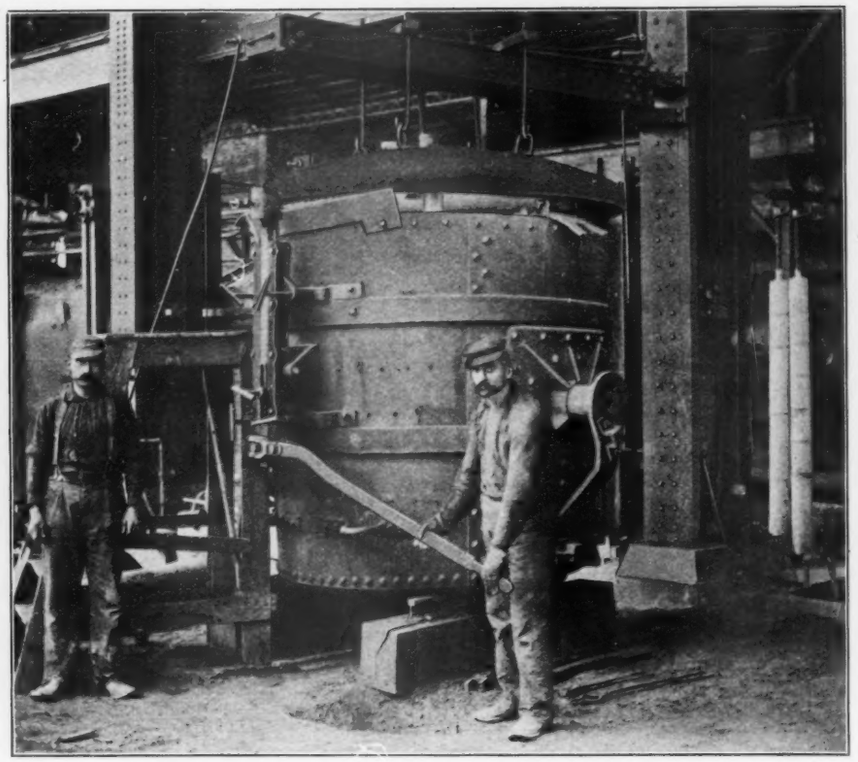


FIG. 8—LADLE HEATING DEVICE

For drying and heating ladles the device shown in Fig. 8 has been installed. The canopy is lined with fire brick and is hung on a swinging bracket attached to one of the columns. When the ladle is to be heated it is placed in front of the column from which the bracket is suspended and the canopy is swung into position and lowered to the top of the ladle. Natural gas mixed with air under pressure is introduced through the canopy into the ladle. In this way very little of the heat is lost and the ladle can be raised to the proper temperature much more rapidly than by any of the other methods generally used in steel foundries.

Annealing Pit.

The annealing pit, located in one of the side bays, is 36 x 24 feet, and 6 feet deep. It is heated by natural gas, the burners being located underneath the floor. The roof is built in three sections and is removed and placed in position by an overhead crane. The crane is likewise utilized for charging the pit and for removing the castings after they have been annealed.

Open-Hearth Furnace.

The charging floor of the 25-ton basic open-hearth furnace is shown in Fig. 9, and the tapping side together with the ladle pit is shown in Fig. 10. The furnace has an extreme width of 60 feet and the hearth is 21 feet long and 9 feet 9 inches wide. Natural gas is used for fuel, two Kirkwood burners having been installed. For emergencies two Forter gas producers have been provided. A plan view and cross section of the furnace and producer installation are shown in Figs. 12 and 13.

The Gas Producers.

The producers are each 10 feet 6 inches in diameter, 13 feet 6 inches high, and the area of gas making surface in each is 63 square feet. These gas producers consist in the main of a circular fire brick lined shell with a gas outlet on the side and a cast iron plate containing a coal hopper and the poke holes on top. The shell and lining are supported by four cast iron columns which rest on the foundation of the producer. An ash hopper, made of heavy steel plates and calked air tight, is suspended from the bottom of the shell and extends a few inches below the top of the ash pan, forming a water seal with the water contained in the pan. At its upper end the ash hopper is provided with a wind box adapted to receive grate sections. A number of air tight doors are located in the wind box through which the grate sections can be inserted and removed. These doors when open give access to the fuel bed through the grate sections so that clinkers that accumulate on the grates can be easily removed from the outside. A row of poke holes just above the wind box gives additional facilities for removing heavy clinkers. The air necessary for gasification and partial

FIG. 9—FURNACE CHARGING FLOOR

combustion is delivered into the wind box by two steam blowers located on opposite sides of the box. A third steam blower delivers air from a centrally located vertical pipe covered with a cone-shaped hood to the center of the fuel bed. The fuel is supported on a bed of ashes which rests in a pan below the hopper. The new ashes that form as a result of the gasification and partial combustion of the fuel slide down into the pan as the combustion progresses, and can be removed from it at any time without interfering with the operation of the producer. The grate is inclined at a steep angle to the horizontal allowing the incandescent fuel and ashes to easily slide down on it. A perfectly uniform distribution of air over the entire area of the fuel bed can be effected by this arrangement. The gas maker has the supply of air completely under his control and he can force more or less air either to the center or circumference of the bosh as the nature of the fuel or the condition of the gas may require. The space between the bottom edge of the gas hopper and the bottom of the ash pan is ample to permit of the easy removal of the largest clinkers.

FIG. 10—TAPPING SIDE OF OPEN-HEARTH FURNACE

Power Plant.

The power plant is 40 x 70 feet and contains two 300-horsepower water tube boilers furnished by the Bass Foundry & Machine Co., Fort Wayne, Ind.; two 250-horsepower Corliss engines, direct connected to 150-kilowatt Wood generators installed by the Fort Wayne Electric Co., Fort Wayne, Ind. Compressed air is furnished all departments of the foundry by Ingersoll-Rand compressors, having a capacity of 800 cubic feet of free air per minute each. Side tracks into the plant connecting with the Toledo & Ohio Central and Pennsylvania railroads, afford excellent shipping facilities.

The officers of the Bucyrus Steel Castings Co. are P. J. Carroll, president and general maanger; Frank P. Donnenwirth, vice president and W. A. Blicke, secretary and treasurer.

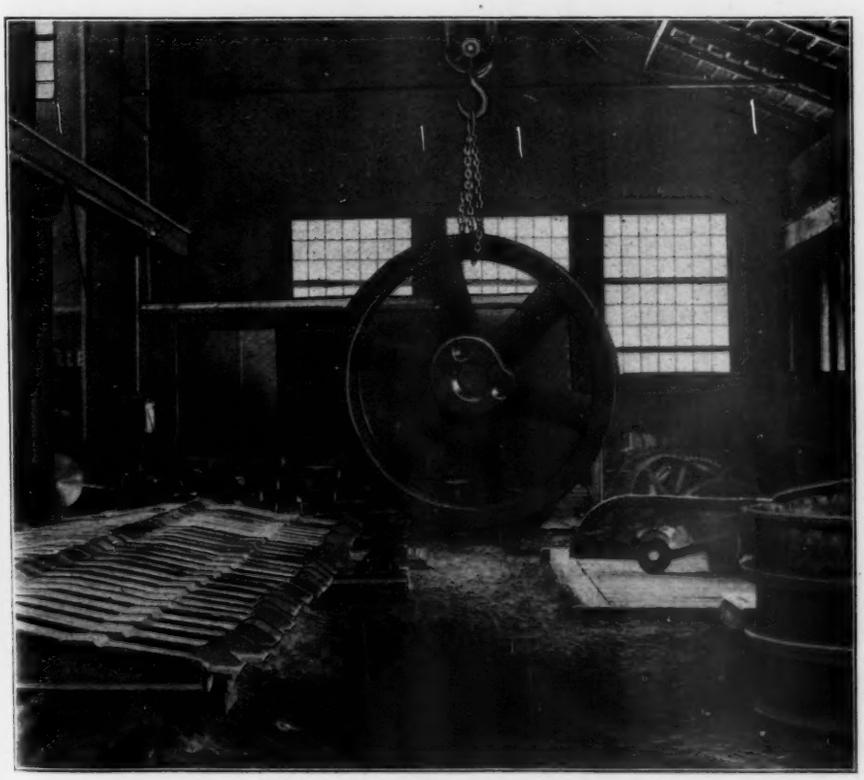


FIG. 11—SHIPPING DEPARTMENT

HARD CASTINGS FOR DIES.

BY ALEXANDER E. OUTERBRIDGE JR.

Question:—Kindly inform us what alloys we should use to get very hard castings to be used for drawing dies. We run from 500 to 2,000 pounds of die work along with our usual melt of machinery castings. We use for the latter No. 2 northern iron with a fair percentage of scrap, sufficient to produce clean, soft and easily machined castings. To deviate from this mixture would be detrimental to our work. We find that by running nothing but dies in one heat and using plow points and other chilled scrap, that the castings are still too soft, although this may be explained by the fact that the dies are of sufficient weight to anneal themselves. Our aim is to find an alloy that will give us the desired results at a minimum cost.

Answer:—There are two distinct methods of accomplishing the results that you desire. One is by the treatment in the ladle of ordinary soft foundry iron with a highly oxidized flux, which burns out a portion of the carbon, silicon and other elements.

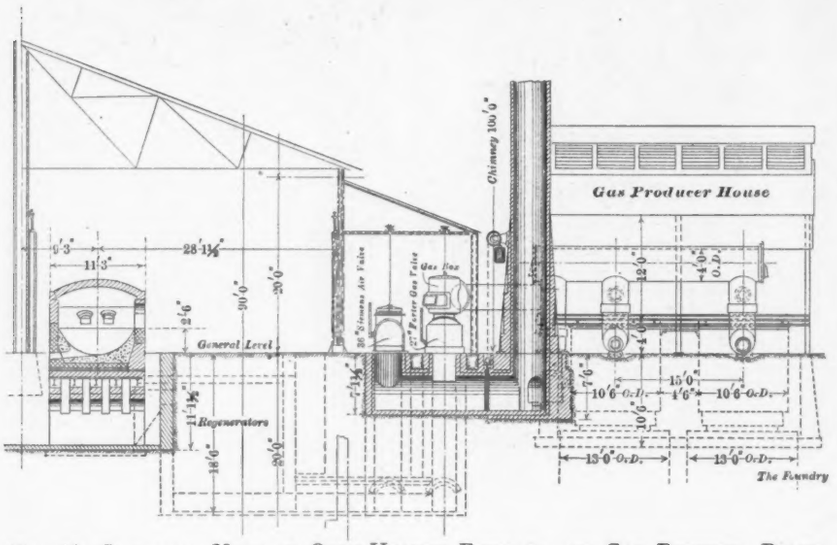


FIG. 12—SECTIONAL VIEW OF OPEN-HEARTH FURNACE AND GAS PRODUCER PLANT

This method requires expert metallurgical knowledge of the reactions involved, as well as numerous experiments to secure definite uniform results.

The other method is comparatively simple, and may be successfully practiced in any foundry. Assuming as in this case, 2,000 pounds of hard castings are to be made and that the run of the metal drawn from the cupola should be clean, soft iron, suitable for making easily machined castings. To do this a special iron mixture of approximately the weight required should be prepared, consisting of steel or wrought iron scrap, No. 3 mill iron and ordinary soft scrap. The steel or wrought iron scrap may be any old material available that is not too chunky to melt readily or too long to pass through the cupola, such as odd pieces of angles, plates, rods, tubing, pipe, punchings, etc.

The proportion of steel or wrought iron scrap to be used depends upon the character and size of the castings, the degree of hardness required, and also upon the percentage of silicon in the soft scrap and pig iron. The quantity of steel or wrought iron scrap will range between 10 and 30 per cent. Without having definite information on these points it is impossible to give an exact formula, but assuming that the drawing dies must be quite hard, but not white iron, that they are fairly chunky castings, and that the silicon in the ordinary scrap approximates 2 per cent, I would suggest the following mixture: Steel or wrought iron scrap 25 per cent, ordinary scrap 50 per cent, mill or No. 3 pig iron 25 per cent. This charge must be melted at the beginning of the heat and preferably all drawn into one ladle to insure uniformity of the mixture. The ordinary chill test pieces, such as are made in car wheel foundries, should be poured and broken to ascertain the depth of the chill, and the closeness of the grain of the gray portion of the metal.

The steel or wrought iron scrap should not be dropped in one mass in the cupola, but should be scattered throughout the charge. On top of this charge a double charge of fuel should be placed and then the usual soft foundry iron added, except that it is well to put some light scrap iron directly on the charge of fuel. It not infrequently happens that every vestige of the steel or wrought iron scrap is dissolved and diffused throughout the first 2,000 pounds of metal and the next succeeding tap gives iron as soft as though no steel had been charged. For precautionary measures it is well to pour about 500 pounds of iron into flask fixtures or counterweights, or some other form where a slight increase of shrinkage, due to the presence of a little hard metal will do no harm.

If the foregoing formula yields metal that is too hard or too high in chilling qualities, the proportion of steel may be diminished. If it is not hard enough, the steel or wrought scrap may be increased to 35 per cent as the maximum, but this is liable to cause excessive slagging followed by dull iron during the rest of the heat.

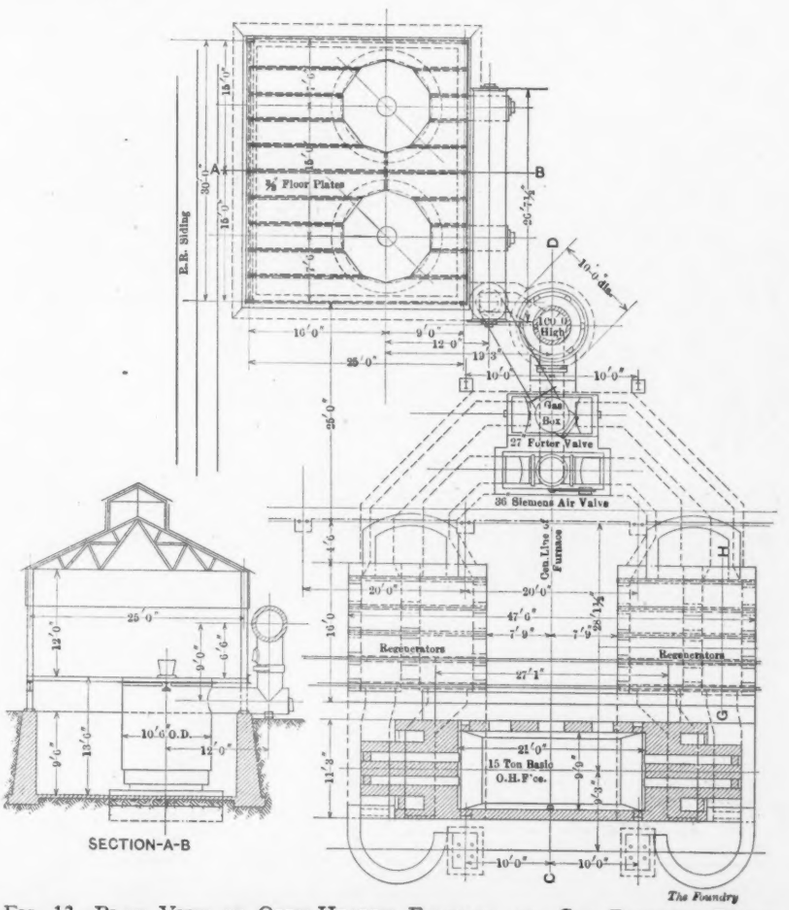


FIG. 13—PLAN VIEW OF OPEN-HEARTH FURNACE AND GAS PRODUCER PLANT

METALS IN FOUNDRY PRACTICE

Questions from Practical Foundrymen are answered in this department by the following experts

CAST IRON . . . . . W. J. KEEP
MALLEABLE IRON . . . . . DR. RICHARD MOLDENKE
METALLURGY OF STEEL . . . . . J. B. NAU
STEEL CASTINGS . . . . . W. M. CARR

OTHER EXPERTS ALSO CONTRIBUTE ADDRESS ALL INQUIRIES TO THE EDITOR

CAST IRON NOTES

BY W. J. KEEP

QUESTION:—We manufacture warm air furnaces for house heating purposes, and have recently had some trouble due to the cracking of the castings in use. The analysis of the broken castings was as follows:

No. 1.—Total carbon, 3.43 per cent; graphitic carbon, 2.945 per cent; combined carbon, 0.485 per cent; silicon, 1.82 per cent; phosphorus, 0.66 per cent; sulphur, 0.07 per cent; manganese, 0.46 per cent.

No. 2.—Total carbon, 3.18 per cent; graphitic carbon, 2.634 per cent; combined carbon, 0.55 per cent; silicon, 2.13 per cent; phosphorus, 0.71 per cent; sulphur, 0.09 per cent; manganese, 0.43 per cent. Do you consider these castings suitable for this work?

Answer:—I do not believe the analysis shows the composition of the castings as they came from your cupola. The contact of fuel while the furnace was in use probably changed the castings to some extent. To best withstand the heat the total carbon should have been 3.60 per cent, combined carbon 0.20 per cent, silicon 2.75 per cent, and the sulphur should be as low as 0.07 per cent. The phosphorus and manganese in your castings are correct. In this line of work, when a casting cracks, its shape should be changed immediately to prevent further breakage, irrespective of the chemical composition. Sharp angles and the uneven thickness of castings have wonderful influence on their tendency to crack.

POROUS SURFACE IN PLATED CASTINGS.

Question:—The castings we are making are scoop shaped, have perpendicular sides and are about 5 inches wide. We run the castings from the open edges of the sides. The whole surface is polished for plating. On the surface of each side, away from the gate, dark spots show on the polished surface, which become very prominent when the castings are plated.

Answer:—Try to make your castings without using facing and pour the iron very dull. If this does not prevent the formation of graphite at these points, then make the sides the same thickness as the rest of the pattern, so that the iron will chill before the graphite forms, and also to prevent the coarse grain that forms in castings that cool slowly. The casting has the appearance of having been pickled with sulphuric acid. Use dilute hydrochloric acid, wash in cold water and dip immediately in hot lime water to neutralize the acid. Sulphuric acid has a tendency to remain in the casting and will discolor the nickel. A good pickling bath should contain 20 gallons of water, one-half gallon of hydrochloric acid and one-half gallon of sulphuric acid. After the surface of the coating is clean, wash in cold water and dip into the boiling lime water, which can be made by dissolving one-half peck of lime in 30 gallons of water.

BLOW-HOLES IN AUTOMOBILE CYLINDERS.

We recently received an automobile cylinder casting but no letter was received giving a description of the same or detailing any of the difficulties experienced with it. The fracture shows a heavy boss in which is located a chaplet and quite a large blow-hole. Evidently the boss is to be drilled and tapped and the blow-hole in this case would do no harm. The metal seems softer than necessary and what appears as shrinkage in another heavy part between two cores indicates that an iron that would set quicker would be more suitable for this line of work. Tinned chaplets should prevent the blowholes. All of the metal that can be spared should be removed from the thick parts of the pattern.

WHITE IRON CASTINGS.

"We sometimes find clear white iron that does not seem to be as hard as some of the other white iron that we produce and the plow points made from it do not last as long as the white iron cast from other heats. Our idea is that the phosphorus must have been high and that the iron remaining fluid longer than with low phosphorus iron, lost some of its sulphur, which has a tendency to change the combined carbon into graphite, thus causing the iron to lose its hardness. The high phoshorus iron, with sulphur ranging from 0.07 to 0.10 per cent, is liable to leave a gray spot at the center of a casting 3 inches thick and of a spongy nature, while the outside of the casting will be perfectly white. Low phosphorus white coke iron, if poured hot into a casting 3 or 4 inches thick, will show a clear white fracture all the way through, but if poured dull will be full of blow-holes, due to the lack of fluidity, which will not permit the gases to escape. It seems to us to secure a perfectly solid clear white casting the iron should be cast in sand and not in chills, and that the phosphorus should be low, as in malleable."

The above is from a founder who makes white iron castings and whose opinion deserves consideration. I have been asked several times for a remedy for white iron, slightly malleable, that could be dented with a hammer. The cutting edges of corn mills would blunt and wear smooth. I directed attention to the fact that there were white irons which would take a chill and which were hard and brittle, and could be used in car wheel mixtures, as well as white iron that would take no chill and which were not so hard.

For castings similar to corn grinding mills and plow points, old scrap car wheels are certain to give a chill and will be sufficiently hard. The non-chilling white irons are very desirable for making malleable castings. I do not know whether the phosphorus or the sulphur has anything to do with this quality.

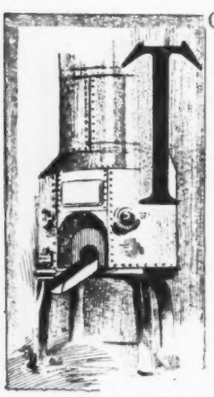
IRON FOR PIANO PLATES.

Question:—We would like to have an analysis of iron which can be used for making piano plates. What should be the breaking load of a 1-inch square test bar, 12 inches long, cast of piano plate iron? Can steel scrap be used in the mixture for piano plates, and if so, what per cent of silicon should be used in the pig iron?

Answer:—Piano plate iron should contain three per cent of silicon, it should be high in graphitic carbon, and should contain 0.75 per cent of phosphorus and 1 per cent of manganese, and should be very low in sulphur. The iron should be poured very hot. The tensile strength should be 26,000 pounds per square inch. One of the largest makers of pianos in New York adds about 10 per cent of steel scrap charged directly into the cupola and advertises that his plates are made of steel. It is stated, however, that this steel does not add to the quality of the casting, but on the contrary, is harmful as it causes hard spots. The following information may be of interest to those contemplating the manufacture of piano plates. Each plate weighs from 180 to 200 pounds and the average thickness is one-quarter inch. The plates are cast, cleaned, carefully chipped and are accurately drilled with 500 holes. They are japanned with two coats of baking japan, and are rubbed down with pumice and water, after which they are dried, sized, bronzed and decorated, baked again and pinned. They are frequently shipped a distance of 1,000 miles, and trucked to the customer's door complete for than $7.00 each. Frequently the founder is requested to accept a four-mouth note, without interest, in payment for his goods. This state of affairs, though startling, is nevertheless true.

A Scrap Pile Argument

BY F. WEBSTER



TONY Swasky said it was and Nic Beltzer said it wasn't, and the spectator, as he listened to the discussion, had to draw his own conclusions, for it seemed that neither of the mental scrappers knew what he was talking about, at least they had not as yet got beyond the stage of stuttering and gesticulation, and become calm enough to state in a rational manner what was what. It all came about one afternoon in May when Tony and Nic were charging the cupola. Each man operated a wheelbarrow, being both driver and horse to his majesty—himself—and transported the scrap mixture from the pile over the plank road via the scales to the elevator reaching the charging floor.

The Warped Baffle Plate.

As they burrowed into the aggregation of worn outs and blasted hopes, on this particular afternoon with spring fever microbes thick in the air, a baffle for a condenser was unearthed. At least that is what one's imagination would signify that the molder rushing his piece work job had anticipated that his casting would be used for. But the output from his tender caresses of the mold, instead of being straight and flat like the pattern, was a cornucopia so beautifully warped that it would not lie still when shaken from the sand. It surely had not stayed on the level before being shaken out, and its hereditary tendencies were too strong to be overcome by the uncertain moral atmosphere of its new environment when the molder first saw the casting.

Nic said the plate reminded him of his experience when a boy. A gang had plundered a watermelon patch, and after the clean up, the whole bunch were in good shape at both ends, but terribly distorted in the middle. It was evident that this particular casting did not enter the cars with a certain shipment of baffle plates, and thus help pay the freight. On the other hand, it is equally certain that one of the molders became better acquainted with that sad word on the board—*discount.*

TONY AND NIC ON THE CHARGING FLOOR

The Puzzle.

But why is it that when melted cast iron is run into a cavity in the sand, the casting does not always have the same form as the pattern used to make the cavity? So there you have the puzzle. Nic said the molder did not make the mold right, while Tony contended that any old mold would do, and that the defect in the casting was all on account of the kind of iron used. But the proof of the quality of a new brand of tobacco is the smoking of it, and so Nic continued the argument by saying that his boy Gust could make 'em right every time, while that sand pounder, Gallitzin from Jersey, never got two castings alike. Besides, "Tony, you know that it is you and myself that mix the

iron every day, and the quality never changes, eh?" With this personal appeal as a clincher, Nic spat on his hands and hitched for the next haul.

Treatise on Sulphur.

However, a man convinced against his will always retains a few microbes in his system, and these generally multiply very rapidly when the individual is in a meditative mood. So Tony began to bring up an array of facts on his side of the question and to drill them for effective argument. He had read some nice essays in the proceedings of the Foundrymen's Souvenir Exchange Club and he was very much impressed as well as mystified by what was said about the influence of the impurities in cast iron. In the first place there is sulphur which makes the iron hard enough for brake shoes when you would rather have soft iron. Besides, it will make blowholes to spare, shorten the casting at both ends, chill the iron and bung the ladle. As molders usually get a surplus of sulphur in this world, they surely ought to escape the brimstone of the next one. It is as idle to expect good castings from sulphur iron as to look for the capitalists and leading citizens among the molders who rush the can.

Manganese for Sick Iron.

For a physic all iron doctors use manganese, and generally with about as little judgment as did the old time bleeders who used lances and blue mass. Under some conditions manganese unites with sulphur and will purify and soften the iron, and thus aids in producing good castings. But when you are just beginning to have that satisfied and comfortable feeling that you know all about how to regulate the quality of the iron by the use of manganese, you get fooled the worst ever, and have the horselaugh from the boys besides. For manganese can make the hardest and worst iron to machine imaginable, while at the same time the casting will give you such a soft, innocent look that no kind of swearing will do the case justice.

Carbon and Phosphorus.

Phosphorus is a good thing for the iron when every crack and crevice of the mold must be filled, providing the casting is not to be used in a very hot place and the strength doesn't count. The dose always stays with the iron, and will increase without coaxing. Lest we forget, it might also be well to bring to mind that we could not have either cast iron or diamonds without carbon. The molder should be acquainted with all its different aliases if he ever expects to understand the causes for the many radically different qualities in castings.

Silicon, the Cure-all.

But when it comes to a show down, to cure all aches and deformities with one medicine from the same bottle, use *silicon* and discharge your chemist. If the iron is too hard, use silicon; if too soft, use silicon; if the shrinkage is too great, use silicon; if it don't shrink enough, use silicon; if the iron doesn't taste right, use silicon; if flat plates warp, use silicon; if you can't estimate the cost of the casting from the blue print, use silicon; well yes, come to think of it, the entire human race needs more sand.

"If the foreman knew how to make a soft mixture, having little shrinkage and chill, and would give the molder clean hot iron for rapid pouring, the mold of course being properly tempered, tamped, faced, gated and vented for thin flat work," said Tony, "there would be no howl about the castings."

Nic's Soliloquy.

"O, yes," said Nic, "science may be all right, but homeopathic doses always cause constipation, and until the molders believe more in the virtue of brains than they do in muscle, they will be unable to digest normal doses of the elixir. Now, Tony, just keep your throttle closed, and do nothing but smoke for a turn, and I will tell you how my Gust beats the discount clerk when molding plates 5½ feet long, 2 feet wide and ½ inch thick. First, he tempers the sand evenly, making it dry enough so that it will just stick. He uses two straight gates in the center, and puts a few nails in the surface where the metal drops, so as to prevent scabbing. The shake out of the box is made in about one-fourth hour or so, leaving the casting on the board. He next draws out of the sand from under about two feet of the central part of the plate to make the casting cool as fast there as at the ends. To prevent a rise in the center he lays a few pieces of pig iron across the top on the sand. The plates come out straight and flat as the top of a billiard table, and I tell you that it is the skill of the boy that does the fine work."

"O, say, Nic," said Tony, "didn't you forget something in that description?" "No, what is it?" replied Nic. "What brand of pig iron did Gust use for the weights?" said Tony, as he dodged behind the scrap pile.

MELTING BRASS BORINGS.

By C. Vickers

Question:—We are experiencing considerable difficulty in melting borings which consist of a mixture of copper, aluminum and zinc, the zinc being in the greater proportion. We have tried repeatedly to melt these borings, but have invariably failed. We secure about 50 per cent metal, and the remainder floats to the surface in the form of dross. Can you give us a process by which the borings can be melted successfully?

Answer:—You must melt this metal at a low temperature when the crucible is first charged. The borings will probably flare when melted and they should be well kneaded down with an iron bar and two ounces of powdered sal-ammoniac added. More turnings are then charged, allowed to become warm, and are likewise pushed into the heated metal. This is to be continued until the pot is filled, then add a couple of ounces of sal-ammoniac, allow the fumes to burn out, remove the pot and skim. The skimmings should be in the form of a fine black dust and if you gently scrape this dust with a skimmer, some of it will revert back to metal which can be recovered by screening. From 400 pounds of turnings I got 73 pounds of dross. I recovered metal from this dross by melting 20 pounds of copper, adding 10 pounds of dross, the result being 27 pounds of metal. On a larger scale I was less successful. I melted 50 pounds of copper adding 40 pounds of dross; result, 70 pounds of yellow brass ingot. If you have large quantities of this zinc dross, it would probably pay you to sell it. When the borings are used direct to make yellow brass the loss is not great. I melted 50 pounds of copper, added 25 pounds of white brass turnings and secured 73½ pounds of castings. The metal obtained is, of course, an aluminum brass, but has a wide range of usefulness, especially for small yellow brass articles. You could also use up the yellow alloy by replacing the copper in your white alloy by the yellow metal, making allowance for the content of zinc. In conclusion I would suggest the use of sal-ammoniac as a flux in melting such metals, as the loss will be greatly reduced in quantity, being in the form of a dust.

THE ANNEALING OF STEEL CASTINGS

Results of the Heat Treatment of Cast Steel from the Experience of a Practical Steel Maker

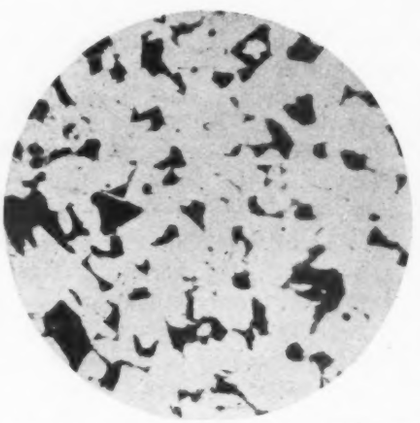
BY E. H. OEHLER

THIS subject has been pretty thoroughly treated in the columns of technical journals during the past few years, but a few results from practical experience may prove interesting and somewhat instructive. Annealing is resorted to for the purpose of removing strains set up in the mold and to give the best possible physical structure to the metal.

When steel solidifies in the mold, there is, as a rule, a good deal of shrinkage; in fact there must be if solid castings are to be expected. The change from the liquid to the solid state sets up strains which are at times so intense that they cause cracks in the metal. These cracks are found shortly after solidification as castings may be stripped at almost a white heat and still be found to contain them. Shrinkage is a variable quantity and at times is entirely absent, the metal expanding and boiling in the gates and risers. This wild steel of course does not produce very solid castings but shrinkage cracks are scarce in such heats. Aluminum wire fed into the stream from the ladle will cause such metal to lay quiet and will increase solidity. Aluminum added at this stage causes a noticeable decrease in the ductility of the product owing to the presence of oxide of aluminum and its use is not to be recommended. The steel does not remain liquid long enough for the alumina to separate. When the aluminum is added in the ladle it is very beneficial as a deoxidizer and the oxide formed rises to the top and passes into the slag.

Shrinkage.

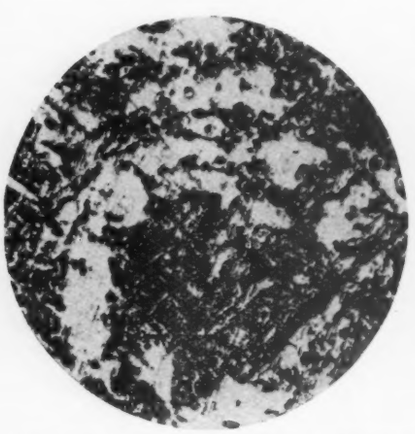
Excessive shrinkage, which of course causes excessive internal strains, can often be reduced by lowering the silicon in the metal. This will not always give the desired results, as several cases of wild metal have come under the writer's observation when the silicons were pretty high and many piped castings have come from low silicon heats. The trouble in these cases must be looked for in the composition of the furnace charge or in the process of melting.



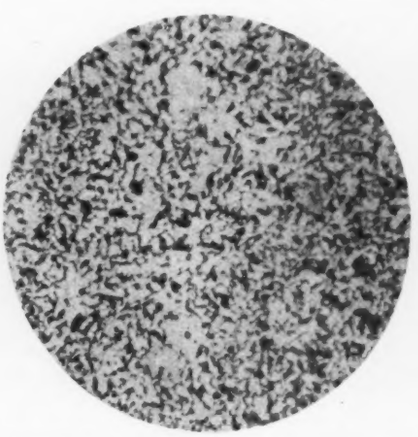
OVERHEATED STEEL, CARBON, 0.25 PER CENT

Annealing.

In annealing to relieve casting strains little regard need be paid to the temperature. To attain the second object of annealing, however, some attention must be paid to the temperature of the annealing furnace. This temperature for practical purposes is not very limited in range and almost any furnace man can obtain good results if checked up occasionally by a microscopic examination of the annealed castings. The accompanying photographs show typical structures, and it is not difficult to recognize seriously underheated or overheated specimens. Even the fracture of the metal will give some information. The grain will not be fine unless the metal has been heated above the critical point. The fracture will not give any information in regard to overheating, but a fine grain will result no matter how much above the critical point the heat has been carried. Steel containing from 0.20 to 0.30 per cent carbon should be heated pretty close to 830 degrees Cent. to give good results. I have noticed very coarse crystallization accompanied by a pretty good microstructure.



SLIGHTLY UNDERHEATED STEEL, CARBON, 0.25 PER CENT



PROPERLY ANNEALED STEEL, CARBON, 0.25 PER CENT

UNANNEALED STEEL, CARBON, 0.25 PER CENT

In every case I have found it due to prolonged heating at too low a temperature.

Results From Ordinary Shop Practice.

Many laboratory investigations have been published and the advantages of annealing are fairly well known, but the appended list of physical results were obtained from ordinary shop practice. Some bars show up much better than others and this may be expected in practical work. The microstructures in all of them are fair, but none are ideal. In every case a material improvement is shown in the annealed specimen and many show a surprising gain in strength. In every instance the annealing increased the tensile strength and this is found to be invariably the case. The elastic limit is also materially improved and the elongation and reduction of area are either practically unaffected or increased. For instance test bar 314 shows an increase of 14 per cent in tensile strength and 22 per cent in elastic limit, while the elongation and reduction of area are practically unchanged. Bar 334 shows an increase of 18 per cent in the tensile strength and 28 per cent in elastic limit. It will be readily seen that such increased strength accompanied as it is by no loss in ductility is well worth the expense of reheating. The tensile strength and elastic limit can be easily raised by increasing the carbon content but in this case the ductility will suffer. It is only by annealing that both the tensile strength and elastic limit can be raised without causing any loss in ductility. Results of a series of tests with raw and annealed steel are given in the accompanying table.

Results of Tests with Raw and Annealed Steel.

Number of test bars.	Elastic limit, pounds per square inch.	Tensile strength, pounds per square inch.	Elongation, per cent.	Reduction of area, per cent.	
312	41,090	74,240	26	36.1	Raw.
313	43,790	81,000	26	35.4	Annealed.
314	40,990	71,030	30	46.7	Raw.
315	50,100	81,540	28	48.0	Annealed.
316	.....	59,400	30	44.5	Raw.
317	.....	69,250	33	54.9	Annealed.
318	30,660	62,200	27	40.1	Raw.
319	32,080	66,200	30	43.1	Underheated.
320	38,200	67,700	33	45.3	Annealed.
321	36,600	69,400	32	53.8	Overheated.
322	30,550	59,670	35	48.2	Raw.
323	32,600	68,600	33	43.6	Underheated.
324	37,700	70,500	33	45.3	Annealed.
334	29,650	62,590	32	49.4	Raw.
335	38,050	73,900	35	58.7	Annealed.
336	29,600	61,100	32	50.8	Raw.
337	35,000	72,100	36	60.5	Annealed.

All bars were cast from basic open-hearth steel containing from 0.20 to 0.27 per cent carbon, 0.60 to 0.70 per cent manganese, 0.30 per cent silicon and phosphorus and sulphur under 0.030 per cent.

BRONZE CASTING MADE OF HARD AND SOFT METAL.

By Geo. W. Kelly

We recently experienced much difficulty in meeting the requirements of one of our customers for the bronze casting shown in the accompanying illustration. It is required to withstand severe strains and shocks and it was suggested that an alloy containing nine parts copper and one of tin be used. The metal proved satisfactory except at the section shown at A which was too soft to withstand the wear to which it was subjected.

We were then requested to make the casting of soft metal except at this point which was to be made of hard bronze. We consulted eminent metallurgists and chemists who claimed that it could only be accomplished by pouring the casting from two separate metals. They advised us to pour the casting of a soft metal mixture and to burn on the hard metal where the casting was to be strengthened. This we did not consider practical and concluded to carry on a series of experiments to solve the problem if possible.

We finally evolved a method that has given very satisfactory results and the casting at one end is made of soft metal and hard bronze at that point subjected to hard wear. Before closing the mold a small piece of metallic phosphorus is placed in the mold at D which is about 1½ inches from the section to be hardened. The phosphorus should be secured to prevent its washing ahead of the metal.

The metal enters the mold at gate B and flows around the piece of metallic phosphorus, which is very fusible and melts almost instantly. It mixes very thoroughly with the metal as it flows to the extreme end of the mold and into the riser C. There is no danger of the hardener getting into any other part of the casting as the metal moves forward until the riser is filled. The amount of phosphorus required is in proportion to the weight of the section of the casting to be hardened.

Bronze Casting Made of Hard and Soft Metal

TARNISHED BRASS CASTINGS.

By C. Vickers

Question:—We experience considerable difficulty owing to the tarnishing of brass castings that we are making. Some of these castings are tarnished within a few days, while others, made from the same mixture and polished in the same way, do not become tarnished.

Answer:—The brass angle stop, badly tarnished, was buffed again and was placed on a shelf in our shop without any covering. After three days it had not become tarnished which shows that the metal is not at fault. Evidently the atmosphere of your shop is contaminated with sulphur, either from the furnaces or the heating apparatus. This is what undoubtedly causes your trouble, as it is impossible to keep polished brass work in the presence of such gases. When this casting was exposed to the fumes of burning sulphur it immediately tarnished, although previously subjected to other severe tests it did not change its color.

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Malleable Castings for Automobiles

The manufacture of malleable cast iron fittings for automobiles, although in its infancy in this country, promises to develop to extensive proportions. For several years foreign builders of high grade motor cars have used malleable castings with excellent results, and one car is now being built in this country which contains no less than 30 malleable parts. The fittings, while only of small sections, have proven very desirable business from the malleable maker's standpoint, owing to the high grade of material specified and the prices the car builders are willing to pay to secure good castings. Another development that is of interest is the decision of several malleable makers against bending castings to shape after they have been tinned. The sudden cooling of malleables after leaving the tinning bath renders them extremely brittle, and they break when an effort is made to straighten or bend them into shape. It is well known that malleable castings, when heated to redness and plunged into water, revert to their former state to some extent. Owing to the heavy losses from broken castings these makers will no longer straighten sections after they have come from the tinning bath.

Trade Outlook

Only a slight improvement has been recorded in the foundry trade during the last 30 days, and with few exceptions gray iron plants continue to operate at about half their normal capacity. The tonnage of malleable castings placed with the makers during March was only slightly in excess of that received in February. The railroads still continue their curtailment policy, and until they enter the market, the manufacturers of malleable castings do not anticipate a reaction from present conditions. The dearth of railroad tonnage likewise affects the steel foundries and they are still operating considerably below their normal capacity. The merchant furnace movement to hold prices on the basis of $17.00 is not being strictly adhered to in all centers. Northern No. 2 foundry iron is being sold on a basis of $15.75, valley furnace, and basic can be had at $15.50. In the Birmingham district the prevailing price is $12.00 a ton for No. 2, but Virginia furnaces are asking $14.00. Further concessions are expected by consumers, who are still drawing upon their stocks accumulated at prices from $8 to $10 above the present level. The non-ferrous metals are firmer, copper having advanced to 13 cents, and pig lead is held at 4 cents a pound, New York.

English Cost-Keeping Methods

At a recent meeting of the Birmingham branch of the British Foundrymen's Association all phases of foundry cost-keeping were discussed. A number of foundrymen complained of the reluctance of their foremen to furnish their managers definite information and data concerning the cost of molding and casting various sections. Without the hearty co-operation of the shop superintendent, no cost system can be successfuly maintained. The ensuing discussion indicates that conditions in the jobbing foundries of England regarding cost methods are not unlike the lax system prevalent in many of the jobbing shops in this country. It was pointed out that success in the foundry business is dependent more upon business acumen than technical knowledge, and that many founders have only a remote idea of what their overhead charges really are. American founders have made rapid strides in recent years, re-adjusting their cost systems, and from many of the methods adopted the exact cost of every section going through the foundry can be immediately secured. These systems, furthermore, enable the foundrymen to make more intelligent estimates on prospective orders, and better prices for castings generally prevail in districts where the more progressive foundrymen are competing against each other.

INSTITUTE OF METALS.

A new society to be known as the Institute of Metals was organized at the Midland Hotel, Manchester, England, on March 10. The meeting was largely attended by copper and brass manufacturers and the objects of the institute are to afford means of communication between members of the trades interested and to arrange periodical meetings for the purpose of discussing practical and scientific subjects relating to the manufacture and use of the non-ferrous metals. The question of organizing an institute was discussed and a resolution favorable to the proposal was carried unanimously. It was considered, however, that it would scarcely be proper to proceed on a resolution passed by a comparatively small meeting, and it was, therefore, determined to appeal to all of those interested in the industries, not confining it to Great Britain. A large number of letters was received

from eminent firms, who are interested in this project. At its periodical meetings, the members of the institute will discuss the manufacture and use of non-ferrous metals and their alloys, more especially copper, zinc, tin, aluminum, lead, nickel, silver and platinum, and will publish twice a year a volume containing abstracts of all papers presented. At this meeting, it was resolved to appoint an influential committee embracing members of the largest copper smelters and consumers to canvass the trade in support of an institute of this kind. Another meeting will be held on June 10, in London, for the purpose of adopting a constitution and by-laws.

PERSONAL.

Benjamin Ogden has been engaged by the Peck-Williamson Foundry Co. to take charge of its plant at Wellston, O., in the capacity of general manager.

Daniel R. Day has been chosen general manager of the Union Malleable Iron Works, Moline, Ill., to fill the place made vacant by the death of Frank W. Gould.

Joseph G. Walton, formerly in charge of the Pittsburg office of the Robert Field Co., has accepted a position with Walter-Wallingford & Co., pig iron merchants, and will travel from the main office at Cincinnati.

Emil Axner has been appointed manager of the Chicago office of Matthew Addy & Co., succeeding Charles L. Miner, who is now with Pickands-Brown & Co., at Chicago. C. C. Boyden, formerly with the Boston office of Matthew Addy & Co., is also associated with the Chicago office.

Charles H. Domhoff, president and treasurer of the Domhoff & Joyce Co., Cincinnati, since the organization of that company, has resigned and retired from active work after 37 years' connection with the pig iron commission business in Cincinnati. John Sargent succeeds Mr. Domhoff as president and treasurer, E. C. Humphreys is vice president and C. H. Jenkins is secretary and assistant treasurer. All have been with the Domhoff & Joyce Co. for years. Mr. Domhoff is still a member of the board of directors.

The retirement of Philip Corbin from the presidency of the P. F. Corbin Co., New Britain, Conn., and from the presidency of the Corbin Cabinet Lock Co., does not mean that the veteran captain of industry intends to retire entirely and no longer participate in the active management of these concerns. He has merely surrendered to others the office of presidency, Chas. H. Parsons succeeding him in the P. F. Corbin Co., and C. H. Baldwin in the Corbin Cabinet Lock Co. Mr. Corbin has not relinquished any of his daily duties, and it is his custom to spend from five to six hours each day in the office of the P. F. Corbin Co.

OBITUARY.

James Meehan died Feb. 28 at his home in Cincinnati, aged 74 years. Born in Ireland, he came to this country at an early age, was reared in Louisville, Ky., and became an engineer on the L. & N. railroad, of which he was afterward master mechanic. He perfected several inventions, including the Meehan brake shoe for locomotives, and the Ross-Meehan Foundry Co., Chattanooga, was organized to manufacture these brake shoes and do a general foundry business. In 1895 he organized a company and built a foundry in Mexico, but afterward returned to Chattanooga and devoted his attention to the Ross-Meehan Co. Five years ago he retired from active business.

James Powell, president of the Wm. Powell Co., Cincinnati, died Feb. 25 at his residence in Avondale. He had been confined to his bed for nearly a year. He was one of the organizers of the National Association of Manufacturers, a founder of the Manufacturers' Club of Cincinnati, and a prominent member of several other associations. He was born in Ghent, Belgium, in 1832, and went to Cincinnati when quite young. He engaged in the general machinery business, building up the Union Brass Works. One son and two daughters survive him.

James H. Oliver, the famous plow manufacturer, died at South Bend, Ind., March 2, aged 84 years. He was born at Roxburgh, Scotland, and in 1836 his family came to this country and settled at Geneva, N. Y. He worked on a farm for a time and then went to Indiana, where he became a mill worker. He soon accumulated enough money to set up in business for himself in a small way. After building up a good business he began experimenting to produce a chilled steel plow, which others, after repeated trials, had declared an impossibility. Mr. Oliver was successful, however, and almost immediately the demand became so great that he had to enlarge his plant. It has never ceased to grow and is now one of the largest in the world. His son, Joseph D. Oliver, will succeed him as president of the Oliver Chilled Plow Co.

John Long, for nearly 20 years superintendent of the local plant of the United States Cast Iron Pipe & Foundry Co., died at Louisville, Ky., Feb. 18, aged 82 years. He was born in Pittsburg and was a brother of the late Dennis Long, who started the manufacture of cast iron pipe in Louisville.

OVER-ANNEALED MALLEABLE CASTINGS.

By Richard Moldenke

Samples of malleable castings received from Illinois show over-annealing very plainly, as well as some molding sand, which gives a clue to the difficulty. The effect of over-annealing may come from two causes; good malleable may be heated too high and long and be thus spoiled, or iron burned in the melting may be annealed under proper conditions and show up the same. It is seldom that molding sand will adhere to a casting persistently after hard-rolling unless the iron has been partially or badly burned in the cupola or furnace. This is because of the presence of oxide of iron which unites with the molding sand to form a sort of a slag. This slag will adhere so firmly that I have seen heavy malleable castings rolled 24 hours in the hard without doing more than polishing the enamel of slag on the casting. Annealing these castings at ordinary temperatures always brought them out appearing over-annealed. It seems that the structure of the burned iron is such that the oxygen present in the annealing pots actually gets into the castings, removing the carbon, but also ruining the strength of the iron. With good sound castings, my opinion is that the oxygen never gets in but the carbon migrates out of its own accord. With lower annealing temperatures, this burning due to over-anneal is not so severe, but one never knows which horn of the dilemma to take, as with good castings a lower annealing temperature will leave the metal under-annealed. Hence the importance of proper melting without burning there.

The castings in question were in all probability bad, before they went into the anneal. There they were over-annealed because the iron could not withstand the temperature, and the scale will always adhere to such castings, as well as the molding sand.

FOUNDRY & PATTERN SHOP EQUIPMENT

Pneumatic Roll-Over Molding Machine—Galvanizing Barrels—Universal Saw Table—Combination Lathe and Gear Cutter—Calumet Cupola—Core Cutting-Off and Coning Machine—Turbine Cupola Blower Set—Exhauster—Rotary Riddle—Killing Roll-Over Molding Machine

THE PNEUMATIC roll-over molding machine shown in the accompanying illustration, built by the Tabor Mfg. Co., Philadelphia, solves the problem of turning over large molds and drawing the patterns on large machines of this type without the use of cranes or hoists. The flask is rolled over and the pattern withdrawn by a centrally located air cylinder.

Fig. 1 shows the machine in its normal position to receive the flask and shows a half flask rammed up ready to be rolled over. Fig. 2 shows the machine after the flask has been rolled over and delivered on the leveling device before drawing the patterns. The leveling device is shown in Fig. 5. The equalizing support is Y-shaped and insures an accurate bearing for the bottom board. A central spring in the hub of the levelling device supports the upper portion upon which the flask rests. This supporting spring holds the moving portion of the leveling device in contact with the bottom part of the flask at three points, until the spherical surfaces at the three points come in contact, when the leveling device is securely locked and held in position until the flask is rammed. When the flask is taken off the leveling device, the upper portion is raised from contact with the lower portion by the spring and is again ready to receive an irregular flask.

Fig. 3 shows the machine with the pattern drawn clean from the sand and Fig. 4 shows the pattern turned back and the mold ready for delivery. All of the foregoing operations, with the exception of ramming and clamping, are accomplished by power, by simply opening and closing the air valves.

The pattern board is equipped with a very heavy vibrator and the patterns shown on this machine have parallel sides, eight inches high. The accurately machined guides on this machine make it possible to draw deep parallel patterns with the aid of draft. The flask shown is 45 x 28 inches and 9 inches high, and weighs 650 pounds, although flasks and pattern boards weighing up to 1,000 pounds can be handled on this machine, which is well adapted for jobbing foundry use and eliminates all of the heavy manual labor on large work.

AUTOMATIC GALVANIZING BARREL.

An automatic galvanizing barrel, constructed in such a way that the shafting bearings and their operating parts are not immersed in the galvanizing solution, is being built by the United States Galvanizing Co., Brooklyn. After the castings have been cleaned and pickled they are charged into the galvanizing barrel which holds from 150 to 200 pounds. The barrel is turned slowly in one direction, and they are given a sufficient coating in from 30 to 40 minutes. Upon reversing the motion of the barrel, the galvanized material is emptied into a water tank which contains a chute where the material is washed. The chute is then raised above the water to permit the material to drain and dry. The thickness of the coating can be regulated to meet requirements, and depends upon the length of time the material is allowed to remain in the barrel. The coating consists of chemically pure zinc and is uniformly smooth and even over the entire surface and has a bright appearance. This method does not affect the temper or the nature of the metal galvanized, and each barrel will handle from 1,500 to 2,500 pounds daily.

TORONTO TESTING LABORATORY.

The Toronto Testing Laboratory, Ltd., Toronto, has been incorporated

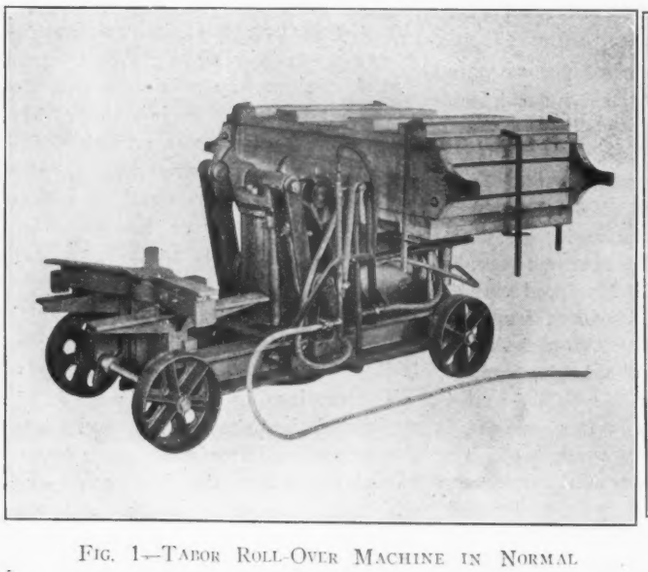


FIG. 1—TABOR ROLL-OVER MACHINE IN NORMAL POSITION

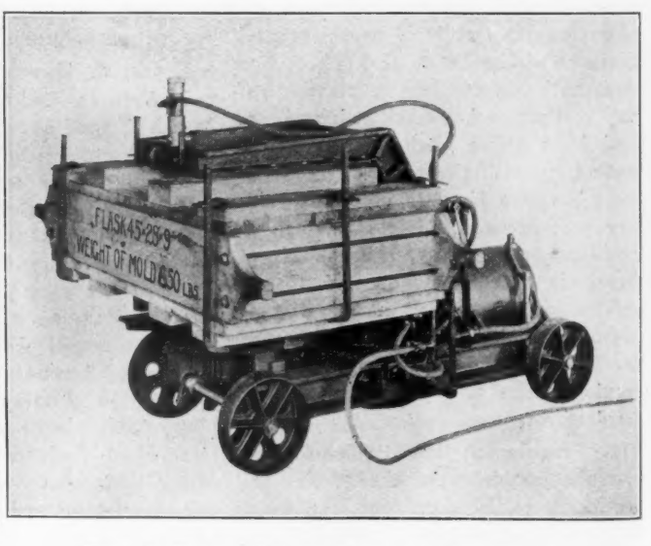


FIG. 2—FLASK ROLLED OVER AND DELIVERED ON LEVELING DEVICE

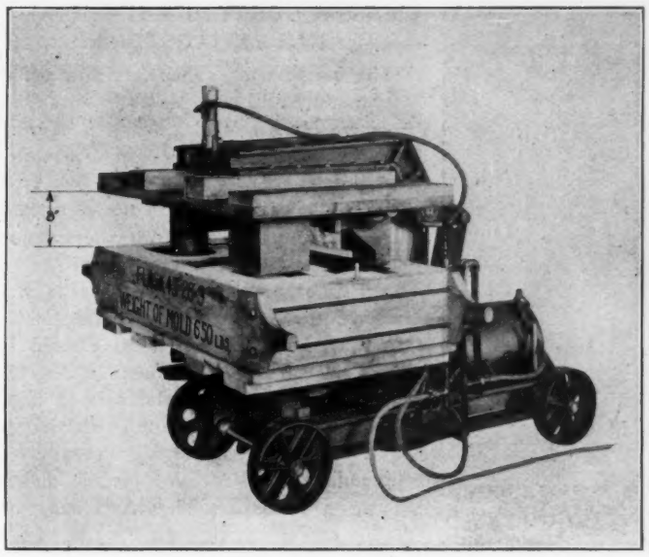


FIG. 3—PATTERN DRAWN FROM THE SAND

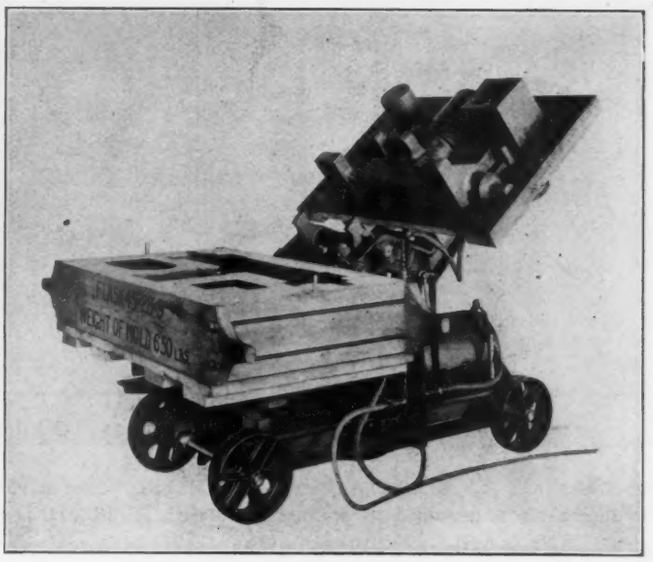


FIG. 4—PATTERN TURNED BACK

and an office has been established in the Saturday Night building. The officers of the company are as follows: President, J. D. Stoddard; vice president, W. P. Putnam; secretary, Henry Blumhart; treasurer and manager, Hugh Lamont.

This concern was organized to look after the Canadian business of the Detroit Testing Laboratory, and although the company is a separate and distinct one, the management and shareholders are practically the same.

Mr. Lamont, who will manage the Canadian business, has had many years' experience in handling analytical work in foundries and has been connected for the last few years with the Detroit Testing Laboratory.

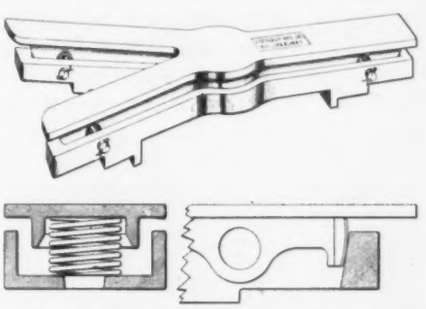


FIG. 5—LEVELING DEVICE, SHOWING SPRING AND CLAMP

As a result of establishing this Canadian concern, better service can be rendered to Canadians than was possible when the business was handled from the Detroit office.

MOTOR DRIVEN UNIVERSAL SAW TABLE.

A motor driven universal saw table built by the Killing Molding Machine Co., Davenport, Ia., is shown in Figs. 1 and 2. The table is 30 inches square and the saw is direct connected to a 1½-horsepower motor. The table is adjustable for any miter,

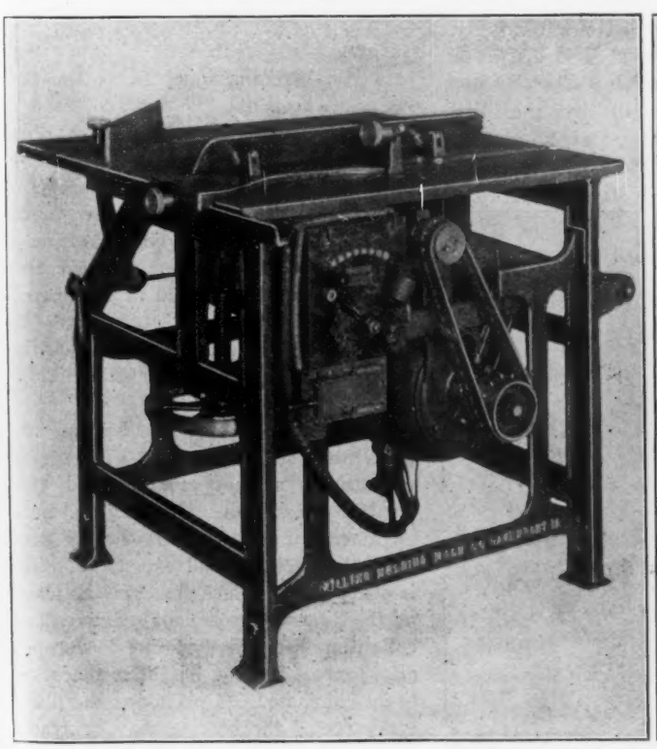


FIG. 1—KILLING UNIVERSAL SAW TABLE

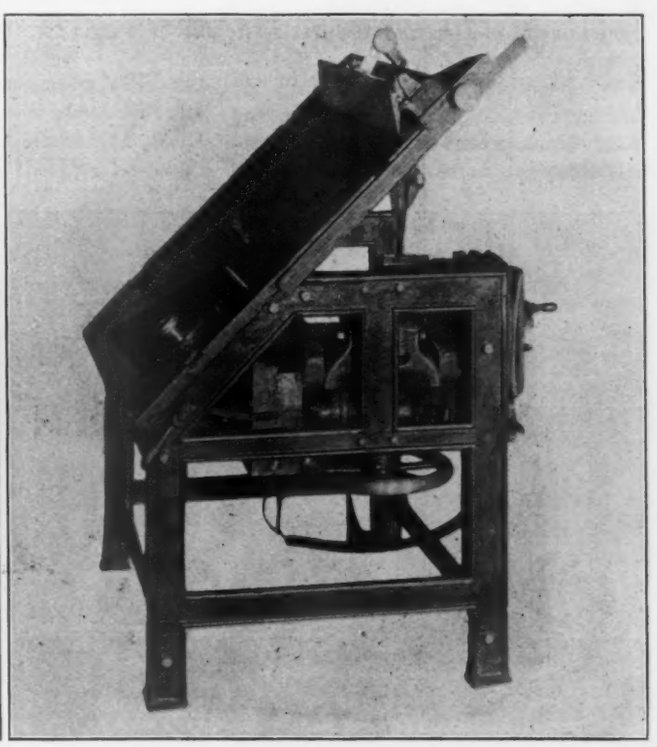


FIG. 2—SAW TABLE TILTED

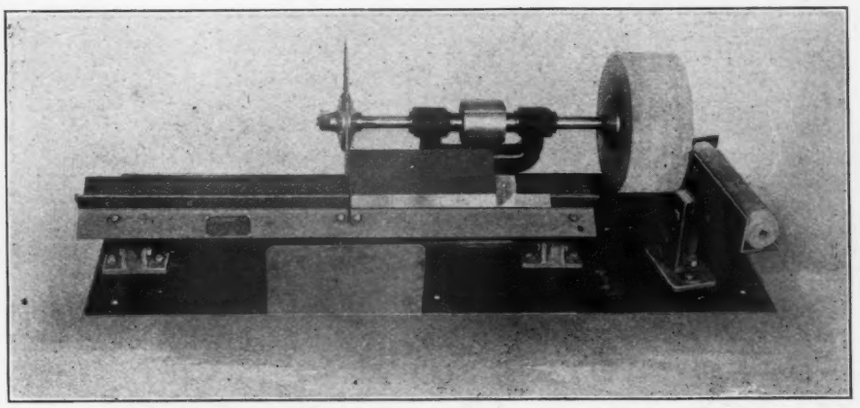


FIG. 1—WADSWORTH CORE CUTTING-OFF AND CONING MACHINE

and is shown tilted in Fig. 2. As no countershaft is required to operate the machine it is self-contained and portable, and may be used jointly in the pattern shop for pattern work; in the foundry for making flasks; or in the shipping room for cutting up stock for crates, etc.

The frame is of the open type and every part of the machine can be inspected without dismantling the table. Any type or style of motor can be furnished as desired.

CORE CUTTING-OFF AND CONING MACHINE.

The Wadsworth core cutting-off and coning machine for coning cores up to 7 inches in diameter and cutting them to any desired length, is shown in Fig. 1. The cutting off wheel is 20 inches in diameter and 3/32 of an inch thick, and operates at 1,000 revolutions per minute.

When cutting off the cores they are laid in a V-rest provided with an end stop, which makes it possible to rapidly cut the cores to any desired length. The machine is also provided with an 18-inch scale. After the cores have been cut they are coned on a cupped emery wheel. The guide in front of the coning wheel is so constructed that the core will be given the desired angle and length of tapered print. Four guides are used for cores ranging in diameter from ½ to 1 inch, 1⅛ to 1½ inches, 1⅝ to 3½ inches and 3⅝ inches and upwards. The guides when set into the supports insure the proper angle and length of taper and require no further adjustment. It is therefore impossible for the operator to change the angle and length of taper, and this always insures the proper coning of the core.

A system of standard core prints and core taper is shown in Fig. 2. The length of the print is shown at A; B is the diameter of the core; C the diameter of the core print center and D is the length of the core print center. The machine is substantially constructed and is built by the Falls Rivet & Machine Co., Cuyahoga Falls, Ohio.

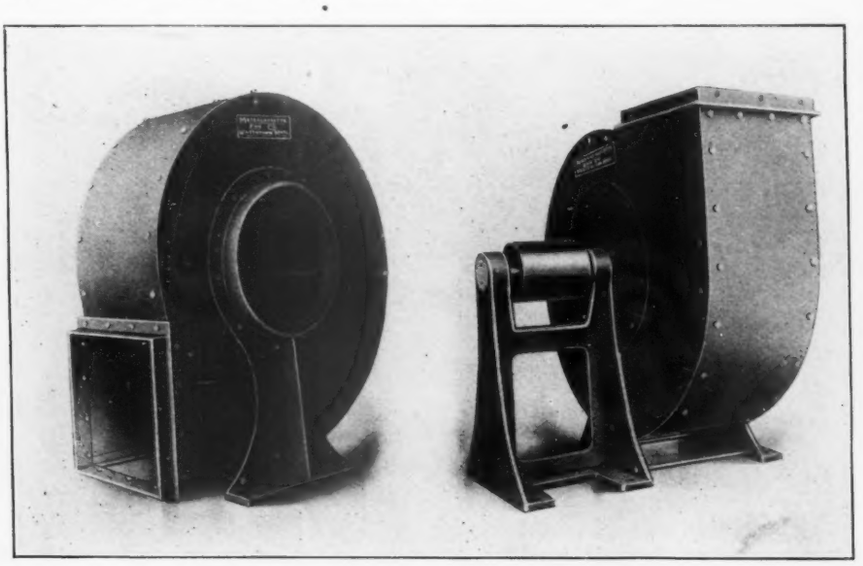
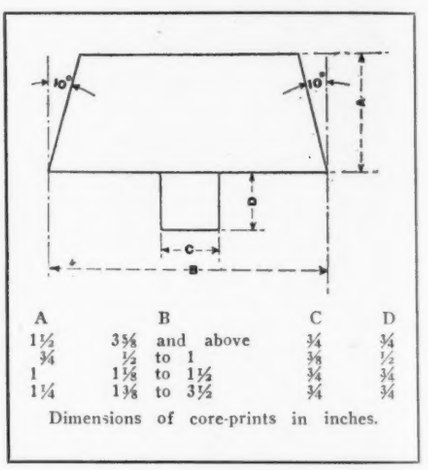


FIG. 1—MASSACHUSETTS BALL BEARING EXHAUSTER

MASSACHUSETTS BALL BEARING EXHAUSTERS.

The ball bearing exhausters now being manufactured by the Massachusetts Fan Co., Watertown, Mass., mark a distinct advance in fan blower design. The bearings, of the Chapman double ball type with single ball races, are made of case hardened cups forced into the hanger and case hardened cones forced on to tapered portions of the fan shaft. Between the two, run hardened steel balls separated by small ball idlers carried in light steel floats, as shown in Fig. 2. The function of these floats is to keep the idlers in the center line of the larger balls, while the idler balls themselves eliminate the destructive grinding action of the load balls. The shaft may be readily driven out through the fan wheel, pulley, and bearings; the taper contact



A	B	C	D
1½	3⅝ and above	¾	¾
¾	½ to 1	⅜	½
1	1⅛ to 1½	¾	¾
1¼	1⅜ to 3½	¾	¾

Dimensions of core-prints in inches.

FIG. 2—SYSTEM OF STANDARD CORE PRINTS

between shaft and inner sleeve thus being easily broken.

The bearings are packed in vaseline when shipped from the factory and require no attention whatever, except a semi-annual repacking. In order to detect any defective parts each bearing is subjected to severe running load tests under pressures measured in tons. Such bearings have been run for months under various conditions without showing the slightest signs of wear or deterioration.

In the smaller sizes, the bearing supports form an inherent part of the hanger, making a very compact and rigid combination, while insuring absolute alignment of the fan shaft. Freedom from the necessity and expense of oiling is also secured. Such fans may be placed in the most conspicuous place without collecting dirt and dust due to escaping oil. Journal friction has been almost entirely eliminated. If necessary the different parts of the bearing may be readily dissembled for inspection or replacement. As an added advantage these fans in

the smaller sizes are made universally convertible, that is they may be adjusted to discharge in any direction. The purchase of an entirely new fan or even the change of hanger is thus obviated. These fans may be made either right or left hand or inverted without reference to the bearings.

The convertible type, with bearings formed in the hanger and with overhang wheel is made in sizes up to and including 60-inch diameter of shell. In larger sizes the ordinary form of casing construction is employed and the bearings are of necessity constructed of independent boxes to be bolted on to the supports. In the larger fans the bearings contain two ball races instead of one as in the case of the smaller sizes. Two case hardened cups are forced back to back into a circular containing ring; a

FIG. 2—BENCH GLUE POT

sleeve is placed at the middle, upon each end of which is forced a case hardened cone. The whole, including balls, is held on pivot center of the ball and socket type by which self alignment is secured. The bearings, each of which is entirely independent of the fan are bolted to cross bars, supported by angle iron uprights, both securely riveted to the fan sheet. The fan shaft is slipped through the sleeve. In both types the balls are thoroughly protected from dust by easily removable washers. There is absolutely no leakage of oil, no pollution of air by odors of heated oil and no soiling of surfaces with which the oil may come in contact. The fire risk incident to dripping bearings and collected lint is entirely obvated.

ELECTRICALLY HEATED GLUE POTS.

The Westinghouse Electric & Mfg. Co., Pittsburg, is placing on the market a line of improved electrically heated glue pots that represent the application of electricity in a simple and convenient form. The pots are made in two-quart and four-quart sizes, in both portable and bench types.

The are especially desirable for use in those crafts where cleanliness is an important factor, where drip from steam pipes means damage to valuable materials, and where the fire risk from a gas heated glue pot is hazardous.

The pots are made of seamless drawn copper with brass bail and wipe rod. The water bath is made of seamless copper, and the heating element, which is wrapped around the lower portion, is enclosed in a water tight tin envelope. The water bath is provided with a patent circulating device, which gives it the maximum heating efficiency. The device consists of a hollow ring, the lower end of which is closed by a diaphragm having a central opening. This confines the heating action to the thin film of water outside of the device, and sets up a rapid circulation in the water, which brings the glue up to the working temperature in a short time.

To further promote economical heating, the pots are provided with heat regulating switches, by means of which the glue can rapidly be brought to the desired temperature and retained at this point by a lower temperature of current.

Fig. 1 shows the parts of the four-quart portable pot, including the water circulating device. Fig. 2 shows the bench pot with the cover in place, giving an unobstructed working surface on the bench. The glue pot and water bath are hung underneath, so as to be out of the way. When the pot is in use the cover is hung on the hook underneath the table. Electrically heated dry glue pots are made for industries where the water bath glue pot is undesirable.

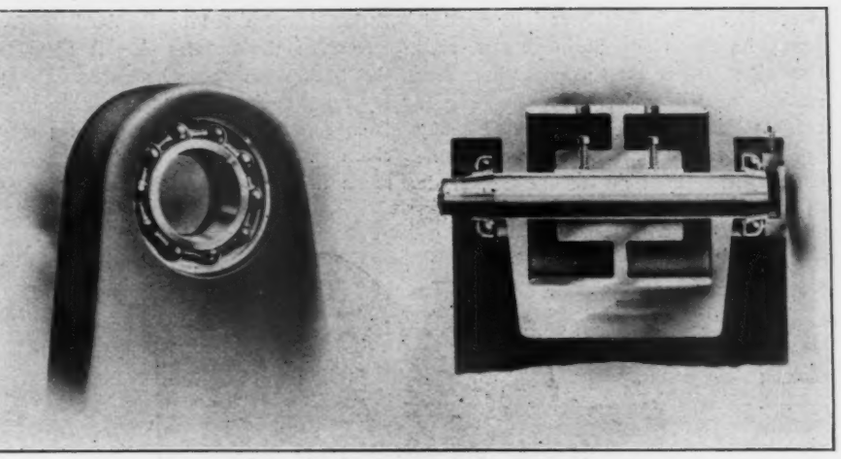


FIG. 2—BEARING OF MASSACHUSETTS EXHAUSTER

A TURBINE CUPOLA BLOWER SET.

The advent of the steam turbine has caused manufacturers of the small sizes

FIG. 1—VARIOUS PARTS OF PORTABLE, ELECTRICALLY HEATED GLUE POT

to consider carefully the various applications. As the steam turbine has a speed somewhat greater than a motor and very much greater than a reciprocating engine it is displacing these for driving many types of machinery. The steam turbine made by the B. F. Sturtevant Co., Hyde Park, Mass., is of lower speed than many other turbines on the market, thus making it particularly adapted for direct-connection to centrifugal pumps, small generators, and fan blowers for high pressures.

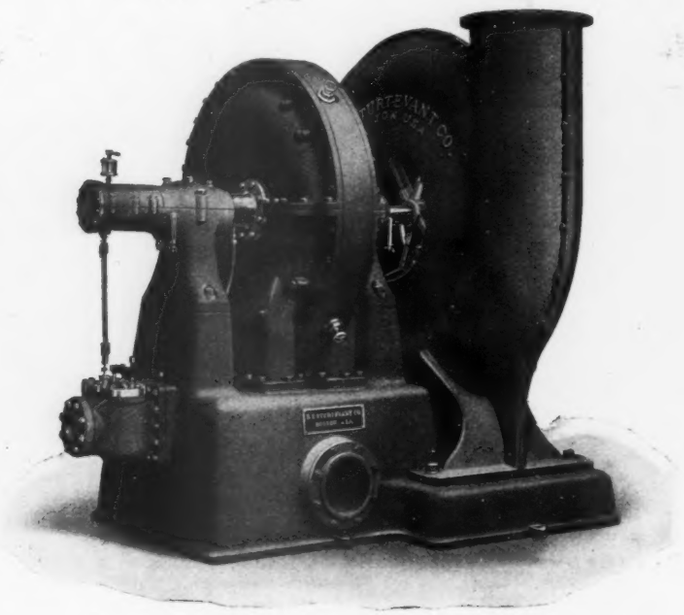


FIG. 1—STURTEVANT TURBINE CUPOLA BLOWER

Probably the most unique application is the Sturtevant turbine cupola blower set shown in Fig. 1. The direct-connection, which does away with all belts and gears, is a decided advantage especially in the foundry. This direct-connected set is made possible by the relative speed and power of the Sturtevant turbine and the cupola blower.

The electric motor can also be direct-connected, but unless of the enclosed type, must be placed at considerable distance from the cupola to avoid the dust and heat. The turbine, being entirely enclosed and dust-proof and not affected by the heat, can be placed close to the cupola, a condition which reduces to a minimum the losses due to friction of air flowing in pipes.

The Sturtevant steam turbine has been built with two objects in view: to obtain durability and simplicity in operation, and low speed. These features have been attained by cutting the buckets in the rim of the solid forging thus preventing any possible damage to the bucket wheel, and the returning again and again of the steam to the same wheel. Figure 2 shows the bucket wheel and the interior of the casing which holds the reverse guide ring. Steam is admitted to the buckets B by means of the nozzles A. It acts upon the buckets in the wheel, reacts in the reversing buckets C, and since the buckets B and reversing buckets C form closed chambers, the steam returns again and again to the wheel each time at reduced velocity and with less energy. After acting and reacting in a group of these closed spaces, the steam in these buckets comes into the buckets D in the reverse guide ring, and as these are open at the inner

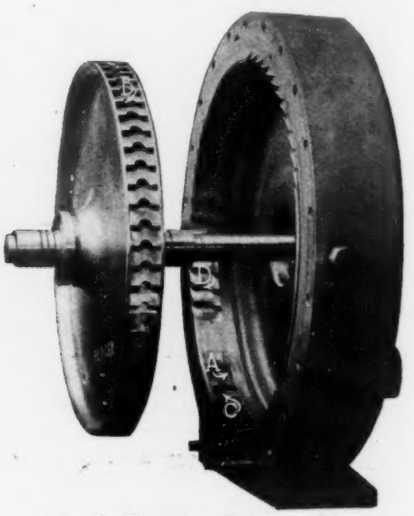


FIG. 2—TURBINE BUCKET WHEEL

edge, the steam escapes into the interior of the turbine casing which is in commuincation with the exhaust passages in the base.

The bucket wheel is placed upon a shaft, which is supported in two bear-

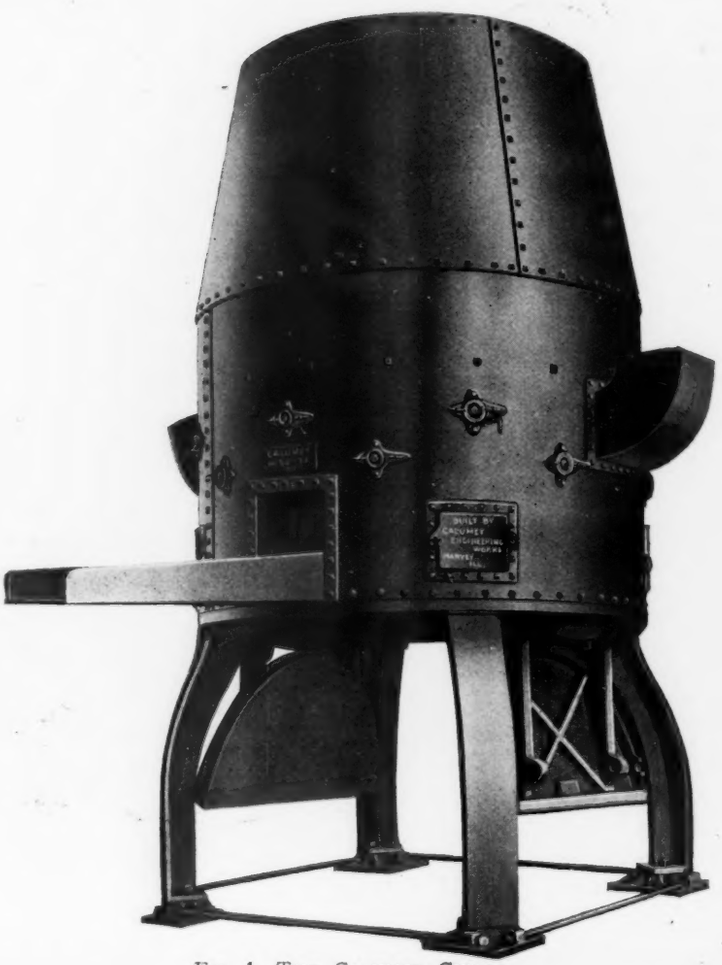


FIG. 1—THE CALUMET CUPOLA

ings, and extended to carry the fan wheel which is overhung upon the shaft. The bearings are of the ring-oiling, self-aligning type with solid linings of phosphor bronze. These bearings are the only parts subjected to actual wear, but this wear is slight for the pressure never exceeds 14 pounds per square inch.

The care taken in the construction of the turbine is shown by the method adopted for balancing the bucket wheel and the extreme accuracy of the tests. With a turbine wheel running at about 2,000 revolutions per minute, absolute accuracy

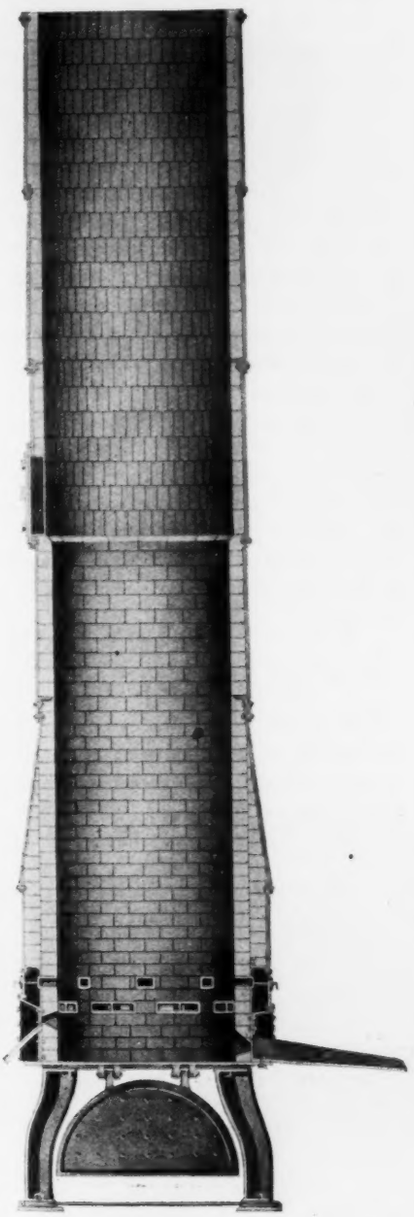


FIG. 2—CROSS SECTION OF THE CALUMET CUPOLA

of balancing is essential. This feature is of far more importance at this speed than with the low speed of the reciprocating engine. Not only must the wheel be placed in perfect static balance, which is easily obtained by means of ordinary parallels, but must be balanced with due consideration for thickness, for the heavy portion may not coincide with the axis of rotation, a condition whch would certainly cause the wheel to shake badly at high speed.

tangular expanded type, properly proportioned to the blower outlet of any standard machine, and provide a nearly continuous blast opening inside the furnace. The upper tuyeres provide an additional air supply to complete combustion, and are provided with

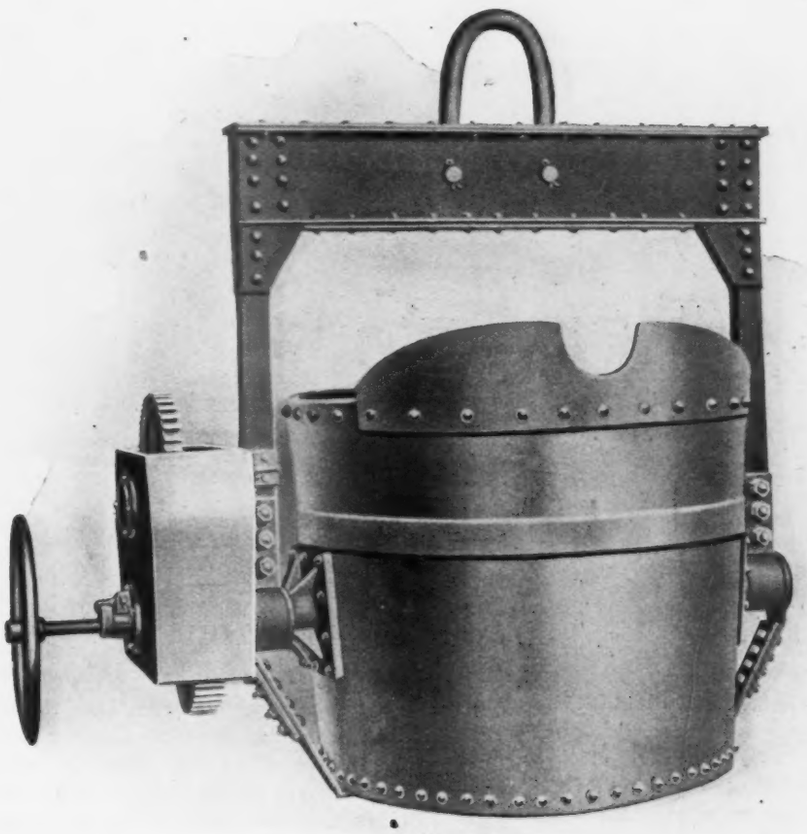


FIG. 3—STEEL PLATE LADLE FOR FOUNDRY USE

THE CALUMET CUPOLA.

The conspicuous feature of the new cupola that is being built by the Calumet Engineering Works, Harvey, Ill., is the location of the air chamber inside of the furnace shell. This construction increases the thickness of the lining at the melting point just above the tuyeres, thus preventing the burning of the shell due to the destruction of the lining at this point. By placing the shell on the outside it is also easily inspected at the bottom. The inside plate of the air chamber is removable and may be replaced when burned out. As shown in Fig. 1, the conical shape of the furnace results in an enlarged base. A cross section of the cupola is shown in Fig. 2. The two blast inlets are located at either side to insure an equal distribution of air in the cupola. They may be attached to suit the location of the furnace. The tuyeres are of the rec- dampers for closing them if desired. A safety tuyere is provided near the slag spout which prevents the molten iron from rising and flowing through the lower tuyeres. The shell and stack are of steel plate construction riveted in sections. Angle lining supports are riveted to the shell at intervals, and standard fire brick can be used for the lining.

The cupola rests on a heavy cast iron flanged base ring to which the furnace shell is bolted on the outside, and the removable air chamber is built on the inside. The cast ring rests upon ribbed columns which stand upon cast base plates held together with steel rods.

The columns are curved to allow the bottom doors to swing back free of the door. Clean out doors are provided in the air chamber, and are machined to insure a perfect fit. The spouts enter the furnace through cast

iron frames in the air chamber bolted to the shell. The slag spout is adjustable to conform to the height of the tuyeres. The furnaces are built in 11 sizes, ranging from 24 to 84 inches in diameter inside of the lining.

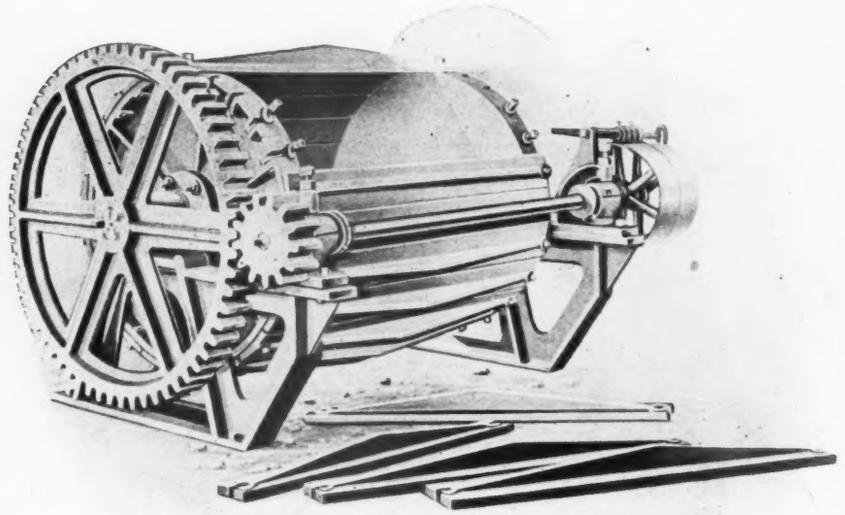


FIG. 4—TUMBLING MILL

The Calumet Engineering Works builds a complete line of foundry equipment, including ladles, tumblers, core ovens, etc. The ladle shown in Fig. 3 is of heavy steel plate construction, the gearing being self-locking and it is provided with an extra safety dog to maintain the ladle in an upright position. The hand wheel is placed low and well to one side for convenience when pouring. The bail trunnions and bowl are well proportioned.

The tumbling mill shown in Fig. 4 is of exceedingly heavy construction, and is designed for rough usage and continuous work. The staves and inside head linings consist of heavy castings, and can be easily removed when worn out. The opening staves are provided with eye-bolts and slotted ends for convenience when unloading. The trunnions are large and are provided with roller bearings which operate in enclosed boxes. The shaft bearings are adjustable.

COMBINATION LATHE AND GEAR CUTTING MACHINE.

A combination lathe and gear cutting machine designed for turning gear blanks and cutting teeth for spur gear patterns is shown in Figs. 1 and 2. A side view of the machine showing the gear blank secured to the plate is illustrated in Fig. 1, and in Fig 2 the movable lathe headstock has been moved up to the gear cutter in position for cutting the teeth. The bed on which the headstock slides is built very heavy to withstand the strains due to high speed and the heavy work mounted on the machine.

After the gear blank has been turned the headstock is moved along the bed to the gear cutter, thus obviating the removal of the face plate to another machine on which the gears are to be cut.

The cabinet frame on which the gear cutter is mounted has four panel doors which make every part of the machine accessible. The front vise jaw of the gear cutter carries an adjustable needle gage point which enables the operator to set his work and without chance of error. The double acting adjustable vise prevents the chattering of the cutter or the springing of the work. This is accomplished by clamping the work at the right place on the rim of the wheel. All of the teeth cut on this machine are uniform in size and are given a smooth finish so that no draft is required, although any desired amount can be given. The high finish given the teeth also obviates the necessity of sand-papering them after they have been cut.

The idle pulley bracket is made to slide on a key so that any desired belt tension can be instantly secured. Six changes of lathe speed are obtained by means of three step cones and a two-speed countershaft. The machine has an almost unlimited capacity, and is equally well adapted for gears from 12 inches to 12 feet in diameter, and from a 2-inch to a 24-inch face. Any number of face plates of different sizes can be furnished by the maker.

By the use of this machine the pattern shop cost of cutting gears is greatly reduced. Fig. 3 shows two gears and a pinion cut in this machine, the gears being respectively 30 and 82 inches in diameter and the pinion 11 inches in diameter. The machine is built by the W. W. Sly Mfg. Co., Cleveland.

DUMP BUCKET.

The Kilbourne & Jacobs Mfg. Co., Columbus, is manufacturing a new line of dump buckets, as shown in the accompanying illustration. The dumping device is so arranged that they may

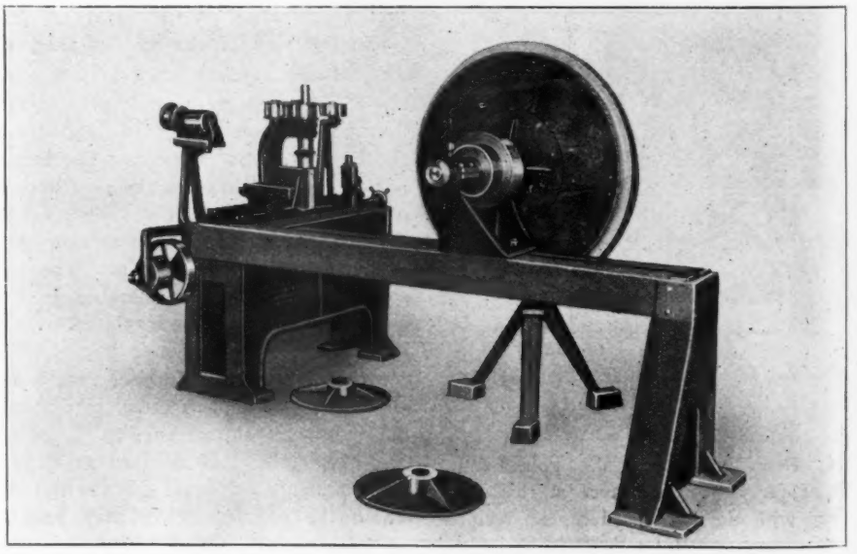


FIG. 1—SLY COMBINATION LATHE AND GEAR CUTTING MACHINE

be dumped from either side, and when righted are locked automatically. This locking device consists of a steel arm which extends around the back of the bucket at the top edge, from bail to bail. When the bucket is righted, shoulders on the steel arm at each side are in contact with latch bars which are firmly bolted to the bail, forming a secure latch and obviating any possibility of accidental discharge. The

DUMP BUCKET

ends of the steel arm project to form the operating levers. To dump the bucket the operating lever is raised at either side and both latches are released. This arm is well protected, being in continuous contact with the bucket, and is placed immediately under the steel band with which the top of the bucket is reinforced. The bucket is steel constructed, being riveted throughout and is provided with a steel plate false bottom, firmly riveted in place. The front, back and bottom of the bucket are made of one continuous steel plate, and the sides are stamped with flanges through which they are riveted to the front, back and bottom plate.

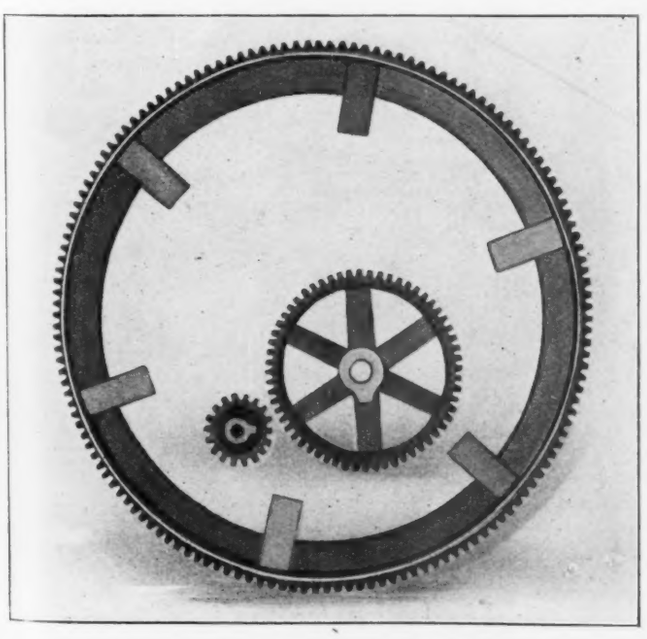


FIG. 3—GEARS AND PINION MADE ON THE SLY LATHE AND GEAR CUTTER

TRADE NOTES.

The Albany & North River Moulding Sand Co., Albany, N. Y., has greatly increased its shipping facilities by the installation of additional side tracks and switches on its 400-acre property near Albany, N. Y. This concern is now in position to handle a larger output than at any time since its incorporation in 1906. Some of the finer grades of sand mined are being shipped to the Pacific coast.

The Northern Engineering Works, Detroit, has installed a 3-motor electric traveling crane having a 50-foot span, in the stove foundry of the Wehrle Co., Newark, O. The crane is of special design.

The March issue of the *Recorder*, published by the Bristol Co., Waterbury, Conn., manufacturers of pyrometers and other recording instruments, contains much interesting reading matter descriptive of the product of this concern.

The February issue of the *Obermayer Bulletin* contains articles descriptive of various technical schools, including the Lewis Institute, Chicago; Armour Institute of Technology, Chicago; the Louisville Manual Training High school, and devotes considerable space to the exhibit of the Chicago Associated Foundry Foremen held at the Lewis Institute early in March.

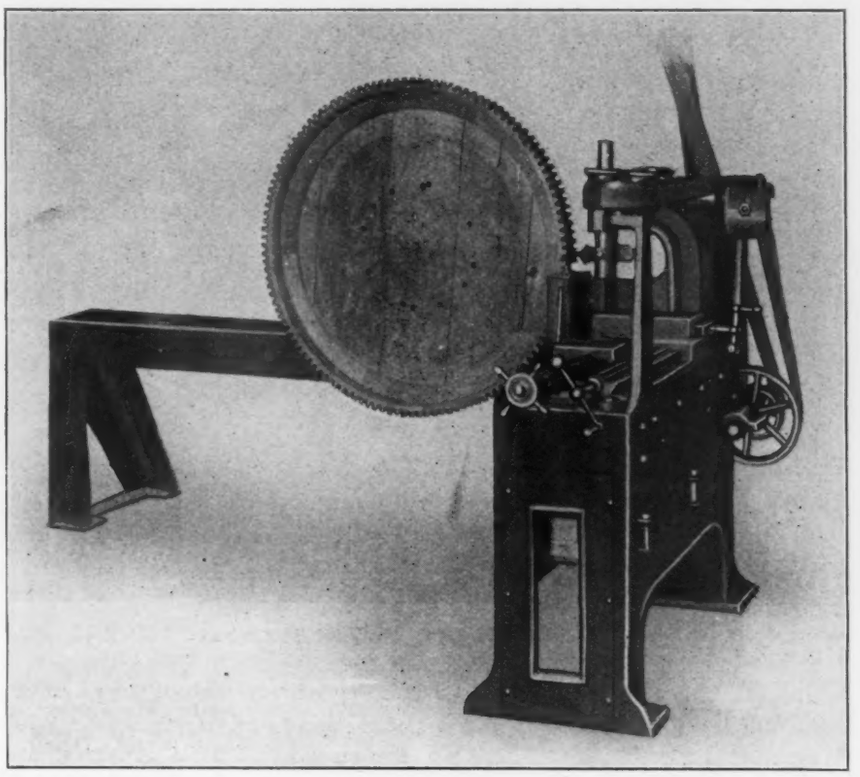


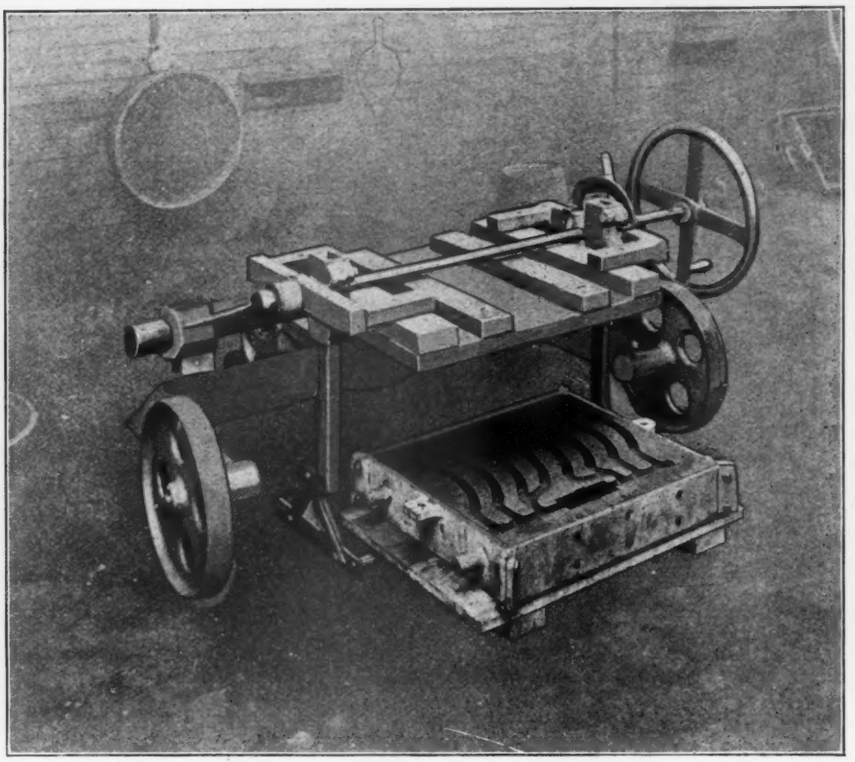
FIG. 2—CUTTING TEETH OF A GEAR PATTERN ON A SLY COMBINATION LATHE AND GEAR CUTTING MACHINE

Reactions is the name of a quarterly, the first number of which has just been issued by the Goldschmidt-Thermit Co., New York. It contains articles on recent improvements in the Thermit welding process, and also describes the method of making repairs on a cast iron water-wheel, 9-inch shaft, and the welding of a rudder post of the steamship Corunna.

The Woburn Iron Foundry Co., Woburn, Mass., has installed a Newten cupola, of four to five tons per hour capacity, furnished by the Northern Engineering Works, Detroit.

The Wisconsin Engine Co., Corliss, Wis., has discontinued its Chicago sales office and for the present the business of that district will be conducted by C. T. Myers, general sales manager of the company.

The Northern Engineering Works, Detroit, has installed a Newten cupola



KILLING ROLL-OVER MOLDING MACHINE

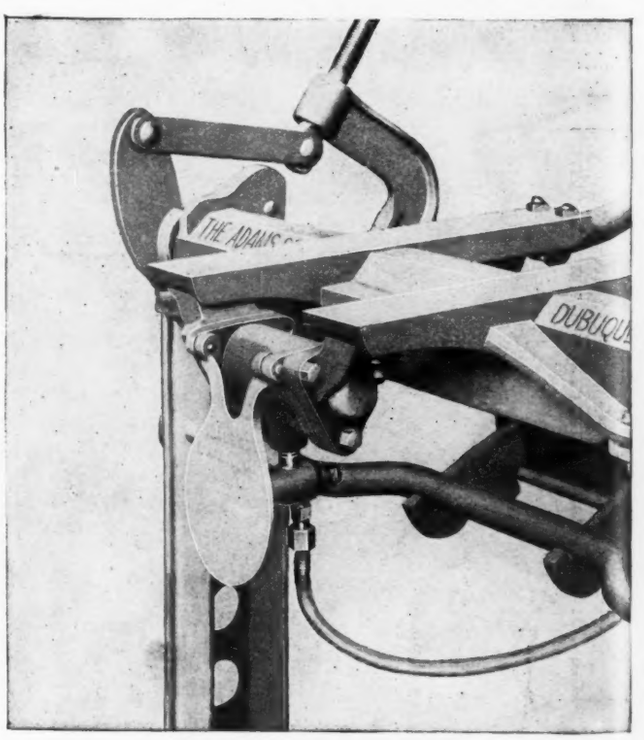
in the plant of the J. C. Woodcock Feed Mill Co., Litchfield, Ill.

THE KILLING ROLL-OVER MOLDING MACHINE.

The roll-over straight drop molding machine built by the Killing Molding Machine Co., Davenport, Ia., shown herewith, embodies many novel features. It is portable, being mounted on three wheels and travels along the sand heap, depositing the molds in a line across the floor. It is adapted for practically all classes of work and both cope and drag can be mounted on one machine. The pattern plate is mounted in such a way that it travels around its own center, the rolling over being facilitated by the weight of the flask. In operation the flask is set on the pattern plate, rammed up, the bottom board adjusted and secured by two automatic adjustable clamps. These clamps are constructed to overcome any irregularities in the bottom board, and are attached directly to the machine frame. After the flask has been clamped the pattern plate is released and the flask is turned over by a hand wheel, and the mold is set on a floor. The machine can also be swung into any position required. The operator can make the molds on one end of the machine and can deposit them on the opposite side so that the floor can be built up without injury to any of the molds previously made. While the machine is built in three sizes for flasks 24 x 36 inches, 30 x 48 inches and 36 x 60 inches, it can be built in any capacity to accommodate flasks of a larger size.

THE ADAMS PNEUMATIC RAPPER.

A pneumatic rapper attached to a 30-inch Farwell molding press, both manufactured by the Adams Co., Dubuque, Ia., is shown in the accompanying illustration. The rapper is used in connection with a pattern plate, which is placed between the cope and drag, and the entire mold pressed at one operation. The plate is then ready to be removed from the sand, which is accomplished by simply pressing the knee against the plate of the pneumatic rapper while the molder lifts the cope and removes the pattern from the drag. The vibrations resulting from the operations of the pneumatic rapper enable the molder to support the flask and remove the patterns quickly without further rapping. It is claimed that less skill is required to draw the pattern from the sand when using this method than is necessary when using gated patterns, as the pattern plate has ears that engage with the pins on the flask and guide the pattern plate as it is drawn from the sand. The rapper, which operates on 40 pounds of air pressure, is furnished ready to attach to molding presses and machines, together with 10 feet of hose. The pattern plates used in connection with this system may be cast of either iron or aluminum, the iron serving as well as any, but the aluminum is preferred as it possesses the advantage of lightness.



THE ADAMS RAPPER ATTACHED TO A 30-INCH FARWELL MOLDING PRESS

ROTARY DUMPING SAND RIDDLE.

An electrically operated rotary sand riddle which can be turned over for discharging the refuse without stopping the motor, is being built by the Hanna Engineering Works, Chicago. The riddle and motor are attached to a frame mounted on trunnions, the

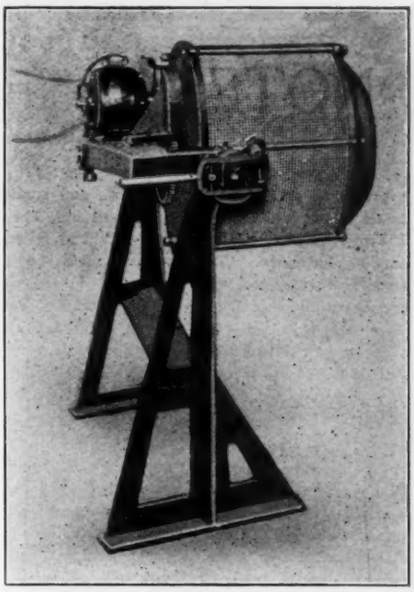


FIG. 1—HANNA ROTARY RIDDLE IN NORMAL POSITION

motor being so placed that it is impossible for the sand to come in contact with it. The riddle in its normal position is shown in Fig. 1, and in Fig. 2, it is shown turned over in position for discharging the refuse. The rotary motion of the riddle also helps the dumping of the accumulated pebbles, nails, shot, etc. The riddle is operated by a 1/5-horsepower motor which is furnished for either direct or alternating current. The screen is held in position by bolts and can be easily changed. The motor at the back of the riddle acts as a counterweight and facilitates the rolling over. The screen is locked in position, the locking pin being released by a lever.

MAGNETIC SEPARATOR.

The Reed magnetic separator for separating iron from brass, copper and all other non-magnetic substances is shown in the accompanying illustration. The hopper is shown attached to the rear of the machine, and the dynamo for generating this electrical energy for the electro-magnetic field is mounted above the machine. The dynamo is so constructed that there is practically no sparking at the brushes, and little or no wear on the commutator. To operate the machine it is only necessary to shift the belt and draw up the interrupter. If at any time any accident should occur to interrupt the magnetic field or reduce it below a certain magnetism, the feed mechanism stops immediately and prevents any contamination of material already cleaned. The intensity of the magnetic field at which the interrupter acts is adjustable, as are also the position of the chute and the feed. The separator is provided with tight and loose pulleys for operating by power and it is also built for operation by hand. The separator has a height over all of 56 inches and occupies a floor space of 22 x 28 inches. It operates at 350 revolutions per minute, and the machine weighs 220 pounds.

USE OF BRASS SCRAP.

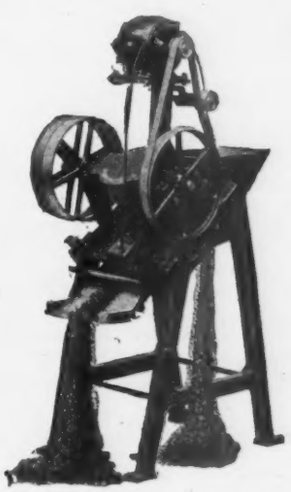
By C. VICKERS

Question:—My scrap metal accumulates faster than I am able to use it. The alloy that I use consists of copper, iron, nickel and tin. At the present time I am using about 20 per cent of the gates. I have tried to use a larger percentage, with the result that the castings were lighter in weight and very spongy.

Answer:—I think you will be able to use up your gates and scrap if you add three ounces of aluminum to every 100 pounds of metal.

TRADE PUBLICATIONS.

FLASKS.—Sterling Wheelbarrow Co., Milwaukee. This concern has issued a 20-page catalog describing its complete line of square and circular ribbed steel flasks. A circular convex flask is also shown, as well as square taper snap flasks, round taper snap flasks, round taper slip flasks and channel iron floor flasks. This concern also manufactures wedges for foundry use, steel foundry trucks, sprue and tote boxes, wheelbarrows, etc.



REED MAGNETIC SEPARATOR

PATTERN SHOP AND FOUNDRY SUPPLIES.—Catalog E, published by the Shanafelt Mfg. Co., Canton, O., manufacturer of pattern shop and foundry supplies, contains 20 pages devoted to the description of leather fillets, pattern letters and figures, wood fillets, fillet tools, rapping plates, lifting screws, dowels, pinch dogs, corrugated fasteners, and a complete line of chaplets. The steel cement manufactured by this concern is also described and directions given for its use and casting brushes, bellows, etc., are also shown.

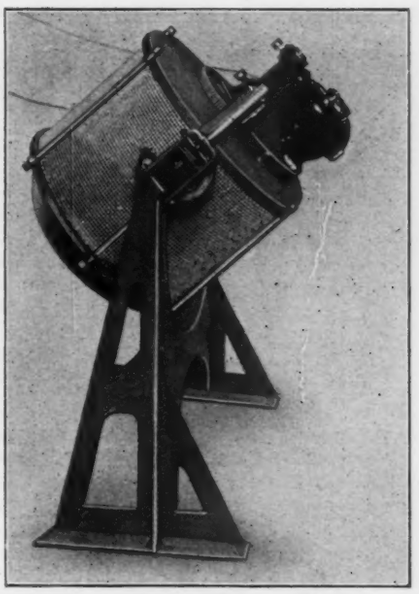


FIG. 2—HANNA ROTARY RIDDLE IN DUMPING POSITION

BLOWERS.—The Piqua Blower Co., Piqua, O., is sending to the trade four circulars describing and illustrating its SS, CD and LP blowers. The SS blower is designed for furnishing blast to large smelting furnaces, while the CD blower is adapted for blast pressures above 16 ounces per square inch and continuous duty. This blower is designed for supplying air to small smelting furnaces, oil-burning furnaces and gray iron foundries. It is provided with gears at each end, the teeth of which are cut out of solid stock. The LP blower is shown direct-connected to a motor, although this machine is also built for belt drive.

PNEUMATIC RAPPER.—The Adams Co., Dubuque, Ia., has issued a 14-page pamphlet describing its Adams pneumatic rapper which is used with pattern plates, and the method of making these pattern plates is also described.

THERMIT.—The Goldschmidt Thermit Co., New York, has issued a 32-page book containing shop instruction for the use of Thermit in repair work. This book should undoubtedly prove of great value to those desiring to make repairs by the use of this material. It contains a large number of views illustrating the various methods pursued.

GAS PRODUCERS.—The Forter-Miller Engineering Co., Pittsburg, has issued a 28-page catalog illustrating and describing the Forter water sealed gas producer and its method of operation. This producer is equipped with the Waldburger feeding device, as well as the Forter water seal reversing valves. The producers are made in five sizes from 7½ to 11½ feet in diameter.

LOCOMOTIVE CRANES.—The Brown Hoisting Machinery Co., Cleveland, has issued a 40-page catalog devoted to a description of its locomotive cranes equipped with grab buckets for handling coal, ore, sand, ashes, etc. The bucket with which this crane is equipped opens by gravity and has a very wide spread when open, and is so shaped that it can be worked in the ends and corners of gondola cars, barges, etc. The shell is made of steel plates, braced and reinforced where the strains are greatest. The sheaves are bronze bushed, and are guarded so that material cannot come in contact with them. The catalog contains a large number of illustrations showing the locomotive cranes in use.

GENERAL INDUSTRIAL NOTES

During a recent suspension electric rammers were installed at the plant of the United States Cast Iron Pipe & Foundry Co., Anniston, Ala. The Bessemer plant of the same company has suspended operations for an indefinite time.

The Notman Stove Co., recently organized with a capital stock of $50,000, by Canton and Alliance business men, will occupy the plant of the Ohio Pressed Sheet Steel Co., in Alliance, O.

The new foundry of the Waterbury Castings Co., Waterbury, Conn., is now ready for operation. The company will manufacture high grade castings for engines and other purposes.

The Galesburg Malleable Castings Co., Galesburg, Ill., has increased its capital stock from $60,000 to $100,000.

The Northern Foundry & Machine Co., Sault Ste. Marie, Mich., is now operating its plant, which includes a machine shop, pattern shop and foundry.

A. T. Benztmyer, proprietor of the Hagerstown Foundry Co., Hagerstown, Md., states that the plant may be moved to another town. The former foundry has been sold and will be torn down and a new site must be found.

The Tell City Foundry & Machine Works Co., Tell City, Ind., has been incorporated by Albert P. Fenn, R. P. Carr, Guy La Rue, Henry Boehrman and Adolph Zuelly, with a capital of $10,000. The new company will build boilers and engines and operate a general foundry and machine shop.

The Mount Rock Foundry & Machine Co., Lewiston, Pa., has been incorporated with a capital of $25,000, by James B. Brown, Chas. A. Reilly, Robert E. Bearley and Charles Z. Bearley, all of Lewistown.

The Vollrath Co., Sheboygan, Wis., has been organized by C. A. W. Vollrath, M. M. Reists, and D. F. Reiss. The new company is capitalized at $10,000 and will engage in the foundry and enameling business.

The American Cast Iron Pipe Co., Birmingham, Ala., reports that during the month of January it made and shipped more pipe than during any one month of 1907. At present it is well supplied with orders and is installing a new department which will considerably increase the output. J. R. McWane, formerly connected with the Lynchburg Foundry & Pipe Works, Lynchburg, Va., has been elected vice president of the company.

The Monarch Foundry & Machine Co., Hillsboro, Tex., has been incorporated by C. B. McConnell, E. B. Guthrie, J. V. Baker and R. P. Freeman, with a capital of $5,000.

The Columbia Brass Foundry, Freeport, N. Y., has been incorporated with $10,000 capital by Robert A. Patrick, George Christian and Mary Christian, Freeport, N. Y.

The Portsmouth Stove & Range Co., Portsmouth, O., has increased its capital stock from $50,000 to $200,000.

The John C. Kupferle Foundry Co., St. Louis, has been incorporated by the following: Emma G. Kupferle, Mildred E. Kupferle, George E. Raithel, Rose G. Kupferle, Mildred E. Kupferle, George E. Raithel, Rose K. Raithel, John P. Woods, Agnes K. Woods, John B. Gross, George W. Pittenger, and Estella K. Pittenger. The company will manufacture and deal in water works specialties.

The Dean-Allan Mfg. Co., Bath, Me., whose incorporation was recently noted, will manufacture brass marine hardware and manganese bronze propellers. It is proposed in the near future to enlarge the foundry, put in more furnaces and add polishing machinery to the machine shop. E. A. Allan is president and W. R. Dean treasurer and general manager.

The Logansport Radiator Equipment Co., Logansport, Ind., is finishing the work of remodeling the old plant of the Dorner Truck Mfg. Co. for its own use.

New Construction.

The new steel casting plant of the Tropenas Steel Co., at Newcastle, Del., is now under construction and part of the equipment has already been ordered. The Shaw Electric Crane Co. will supply a 10-ton electric travelling crane and two blowers, motor driven, have been ordered from the P. H. & F. M. Roots Co. The purchase of machine tool equipment will not be considered for several months.

The new plant of the Campbell Mfg. Co., Gadsden, Ala., will consist of four buildings, 100 x 250 feet, 50 x 80 feet, 40 x 60 feet, and 20 x 40 feet, respectively. The company was organized recently for the manufacture of plumbers' supplies and has already purchased the equipment for its plant.

The Purcellville Foundry Co., Purcellville, Va., whose foundry was recently destroyed by fire, will rebuild its plant this spring. Most of its equipment is already at hand.

James B. Clow & Sons, Chicago, now operating a pipe plant at Newcomerstown, O., have made an agreement with the board of trade of Coshocton, O., to build there a large pipe and radiator plant if the city will donate them a bonus of $100,000 and a tract of land for the site. The company is seeking a favorable location for the erection of a larger plant than its present one at Newcomerstown, and it is estimated that nearly $1,000,000 will be expended on the new plant, which will include a large foundry.

The A. Moresi Co., Ltd., Jeanerette, La., has completed an addition, 83 x 115 feet, to its present foundry. Three cupolas, having a melting capacity of 40,000 pounds per hour, have been added to its equipment.

The Ardmore Foundry, Machine & Bridge Co., Ardmore, Okla., is planning the early erection of an addition to its plant, which now consists of one building, 100 x 200 feet.

Frank P. Lannon, president of the Pueblo Foundry & Machine Co., Pueblo, Colo., recently made a trip to the east to order machines and cupolas for the company's new steel casting plant. Plans for the buildings are now being made.

The New Phoenix Foundry & Machine Co., Springfield, Mo., has prepared plans for a one-story pressed brick building, 50 x 87 feet, to cost about $4,000. The machinery equipment will probably we added to later in the year. Gray iron and brass castings are manufactured.

The Coatesville Foundry & Machine Co., Coatesville, Pa., is erecting a plant for the manufacture of grate bars, boiler fronts and similar castings. It will include a main building, 114 x 208 feet; pattern shop, 40 x 60 feet, and several smaller buildings. The buildings will be of structural steel and will be erected on the site purchased by this company a few months ago. The equipment has already been purchased and the plant will probably be in operation before fall.

The Strong Steel Foundry Co., Buffalo, N. Y., recently incorporated, will equip the buildings formerly occupied by the Buffalo Cement Co., at Main and Amherst streets, for the production of a line of standard open-hearth steel castings, as well as special steels for different purposes, including manganese, vanadium, chrome and other grades. Electric crane, motors, sand grinder, ladles, cars, and other steel foundry equipment, will be required.

C. D. Gordon, of Oskaloosa, Ia., is planning the construction of a brick building at Shenandoah, Ia., where he will establish an iron foundry.

The Pueblo Iron Foundry, recently incorporated by T. H. Devine, A. H. Moll, F. W. Preston and others, has purchased a building from the Steel Wheel & Wagon Co., Minnequa, Colo. The company plans to improve the plant and install machinery as soon as possible for the manufacture of iron and steel castings.

A. J. Harper has purchased land at Portland, Ore., for the sum of $13,000, upon which he plans to erect a large brick building for use as a brass foundry.

The Columbian Brass Foundry Co., Freeport, L. I., recently incorporated by George Christian and others, has bought the plant of Robert A. Patrick and contemplates putting up a new building 20 x 80 feet for foundry work. The company will manufacture propeller wheels and boat fittings as a specialty. Robert A. Patrick will remain with the company as general manager.

The large stove foundry which B. B. Cohen, of Sheffield, Ala., is constructing at Florence, Ala., is nearing completion. The building is 100 x 255 feet, with an annex 50 x 100, and an ell 50 x 50, making it one of the largest stove plants in that district. Patterns are being made so that operations may be started at the earliest date possible.

The Southern Stove Works, Evansville, Ind., states that the damage done to its plant by fire on March 5 has been greatly exaggerated. The total loss, due to the destruction of one pattern storage house and its mounting room, did not exceed $20,000. Arrangements have been made to rebuild the burned portion of the plant and orders are being filled promptly from the stock on hand.

The McInnes Steel Co., Corry, Pa., has begun the manufacture of steel castings in its new plant, which is being operated almost to its full capacity to fill the orders for its product.

The Duquesne Steel Foundry, Pittsburg, has installed a gas power system to take the place of steam in the operation of its works. A 400-horsepower Westinghouse gas engine of the three-cylinder vertical enclosed type, directly connected to a 240 K. W. generator, will serve the various motor drives around the plant. The plant will operate on natural gas, which is available at such low rates as to render gas power the cheapest form of power available in that section of the country.

Interior Foundry View, Merrimac Iron Foundry, Lawrence, Mass.

This modern foundry equipped with two *Whiting* Electric Traveling Cranes, *Whiting* Cupolas, Ladles, Tumblers, Trucks, Turntables, etc.

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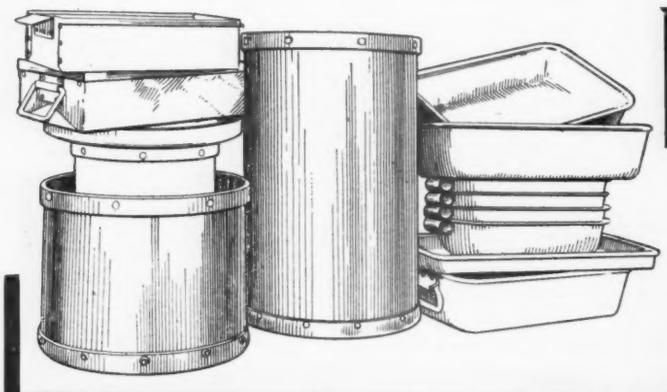

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Accountants:

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Air Compressors:

American Air Compressor Works, New York.
Curtis & Co. Mfg. Co., St. Louis.
Norwalk Iron Works Co., So. Norwalk, Conn.

Alloys:

Blackwell, Geo., Sons & Co., Ltd., Liverpool, Eng.
New Era Mfg. Co., Kalamazoo, Mich.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Analysis—Mechanical:

Keep, W. J., Detroit.

Analysis—Chemical:

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Kessler & Wiedemann, St. Louis, Mo.
Metallurgical Laboratory, Pittsburg.

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Ajax Metal Co., Birmingham, Ala.
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Connersville Blower Co., Connersville, Ind.
Cornell, J. B. & J. M. Co., New York.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson, J. W. Co., Philadelphia.
Piqua Blower Co., Piqua, Ohio.
Roots, P. H. & F. M. Company, Connersville, Ind.
Sturtevant, B. F., Co., HydePark, Mass.

Blowers—Positive Pressure:

Connersville Blower Co., Connersville, Ind.
Piqua Blower Co., Piqua, Ohio.
Roots, P. H. & F. M. Company, Connersville, Ind.
Sturtevant, B. F., Co., HydePark, Mass.
Wilbraham-Green Blower Co., Philadelphia.

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American Wire Brush Co., New York.
Osborn Mfg. Co., Cleveland.

Burners (Oil):

Monarch Engineering & Mfg. Co., Baltimore.
Rockwell Engineering Co., New York.

Carbanese.

Midvale Mining & Mfg. Co., E. St. Louis, Ill.

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Phosphor-Bronze Smelting Co., Ltd., Philadelphia, Pa.

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Otis Steel Co., Ltd., Cleveland.

Cement (Furnace):

Gautier, J. H. & Co., Jersey City.

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Clark Cast Steel Cement Co., Shelton, Conn.
Shanafelt Mfg. Co., Canton, O.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Chaplets:

Burdick & Son, Albany, N. Y.
Lindsay, W. W. & Co., Philadelphia.
Shanafelt Mfg. Co., Canton, O.
United States Chaplet & Supply Co., New York.

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Toledo Mfg. Co. Toledo, O.

Clay.

Haedrich, E. M., Philadelphia, Pa.

Coke:

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Debevoise-Anderson Co., New York.
Hillman, J. H. & Son, Pittsburg.
Rogers, Brown & Co., Cincinnati.

Conveyors:

Link-Belt Co., Philadelphia, Pa.

Cores:

Brown Specialty Machry. Co., Chicago.

Core Binders:

Robeson Process Co., Au Sable Forks, N. Y.
Sterling Oil Co., Emlenton, Pa.

Core Machines:

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Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Jones & Atwood, Stourbridge, Eng.

Core Ovens:

Atlas Car & Mfg. Co., Cleveland.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Hill & Griffith Co., Cincinnati.
Millett Core Oven Co., Brightwood, Mass.
Pangborn Company, Thomas W. New York.
Paxson, J. W. Co., Philadelphia.
Roberts Portable Oven Co, Chicago.
Smith, J D., Foundry Supply Co., Cleveland.

Core Oven Recording Thermometer:

Bristol Co., Waterbury.

Core Tapering Machines:

Brown Specialty Machry. Co., Chicago.

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Cleveland Crane & Car Co., Wickliffe, O.
Curtis & Co. Mfg. Co., St. Louis, Ill.
General Pneumatic Tool Co., Montour Falls, N. Y.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia.
Niles-Bement-Pond Co., New York.
Northern Engrng. Works, Detroit.
Ridgway, Craig & Son, Coatesville, Pa.
Sellers, William & Co., Inc., Philadelphia.
Whiting Foundry & Equipment Co., Harvey, Ill.

Crucibles:

Brass Founders Supply Co., Newark, N. J.
Dixon Crucible Co., Jos., Jersey City.
Gautier, J. H. & Co., Jersey City.
McCullough-Dalzell Crucible Co., Pittsburg.
Monarch Engineering & Mfg. Co., Baltimore.
Paige Retort & Crucible Co., Taunton, Mass.
Paxson, J. W. Co., Philadelphia.
Ross-Tacony Crucible Co., Philadelphia.
Seidel, R. B., Inc., Philadelphia, Pa.
Taylor, A. L., San Francisco.
Taylor, Robt. J., Inc., Philadelphia.

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Detroit Foundry Supply Co., Detroit.
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Gilmour, J., New York.
McCormick. J. S. Co., Pittsburg.
Northern Engineering Works, Detroit, Mich.
Paxson, J. W. Co., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.
Wonham & Magor, New York.

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Ridgway, Craig, & Son, Coatesville, Pa.

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American Blower Co., Detroit.

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Dodge & Day, Philadelphia.
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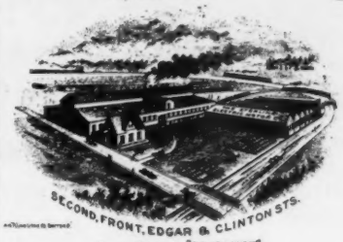

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Maurer, Henry, & Son, New York.
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Wm. Penn., Silica Works, Wm. Penn, P. O., Philadelphia.

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Carborundum Co., Niagara Falls, N. Y.

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Barnett, Oscar, Fdy. Co., Newark.
Brass Founders' Supply Co., Newark.
Killing Molding Machine Co., Davenport, Ia.
McPhail Flask & Mch. Co., Chicago, Ill.

Flasks (Snap):

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Diamond Clamp & Flask Co., Richmond, Ind.
Killing Molding Machine Co., Davenport, Ia.
McPhail Flask & Mch. Co., Chicago, Ill.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.

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Barnett, Oscar, Foundry Co., Newark.
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Obermayer, S. Co., Cincinnati.
Pangborn Company, Thomas W. New York.
Sly, W. W. Mfg. Co., Cleveland.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

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Crivel & Co., Geo. F., Buffalo.
Detroit Foundry Supply Co., Detroit.
Hill & Griffith Co., Cincinnati.
McCormick, J. S. Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Osborn Mfg. Co., Cleveland.
Pangborn Company, Thomas W. New York.
Paxson, J. W. Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, A. L., San Francisco.
Taylor, Robert J., Inc., Philadelphia.
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Brass Founders Supply Co., Newark, N. J.
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Paxson, J. W. Co., Philadelphia.
Rockwell Engineering Co., New York.

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Northern Electrical Mfg. Co., Madison, Wis.

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Sturtevant, B. F., Co., HydePark, Mass.

Hoists:

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General Pneumatic Tool Co., Montour Falls, N. Y.
Niles-Bement-Pond Co., New York.
Pawling & Harnischfeger, Milwaukee.
Sellers, William, & Co., Inc., Philadelphia.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Hoists (Electric):

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Yale & Towne Mfg. Co., New York.

Hoists (Hand):

Northern Engrng. Works, Detroit.

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Ridgway, Craig, & Son, Coatesville, Pa.

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Atlas Car & Mfg. Co., Cleveland.

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Rogers, Brown & Co., Cincinnati.

Lumber:

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Arcade Manufacturing Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Herman Pneumatic Machine Co., Zelienople, Pa.
Killing Molding Machine Co., Davenport, Ia.
Manning, Maxwell & Moore, New York.
Mitchell-Parks Mfg. Co., St. Louis.
Mumford, E. H. Co., Philadelphia.
Paxson, J. W. Co., Philadelphia.
Pridmore, Henry E., Chicago.
Rathbone, John A., Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.
Tabor Mfg. Co., Philadelphia.

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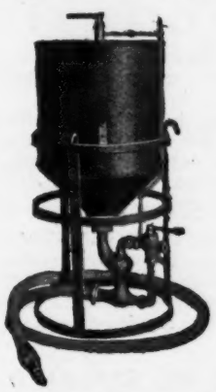

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Mohr, J. J., Philadelphia.
Nash, Isham & Co., New York.
Pickands, Brown & Co., Chicago.
Pickands, Mather & Co., Cleveland.
Pilling & Crane, Philadelphia.
Rogers, Brown & Co., Cincinnati.
Shepard, Chas. G., Buffalo.
Stevens, F. B., Detroit.
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Thomas Furnace Co., Milwaukee.
United Iron & Steel Co., Pittsburg.
Walter-Wallingford & Co., Cincinnati and Pittsburg.

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Gautier, J. H., & Co., Jersey City.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
McCullough-Dalzell Crucible Co., Pittsburg.
Obermayer, S. Co., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
Ross-Tacony Crucible Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.
Stevens, F. B., Detroit.
Whitehead Bros. Co., New York, Providence, Buffalo.

Polishers' and Planers' Supplies:
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Riddles:
Adams Co., Dubuque, Ia.

Sand:
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Newport Sand Bank Co., Newport, Ky.
Haedrich, E. M., Philadelphia, Pa.
Pangborn Company, Thomas W. New York.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.
Whitehead Bros. Co., New York, Providence, Buffalo.

Sand Blast Machinery:
Drucklieb, C., New York.
Pangborn Company, Thomas W. New York.
Paxson, J. W. Co., Philadelphia.
Tilghman-Brooksbank Sand Blast Co., Philadelphia.

Sand Mixing Machinery:
Falls Rivet & Machine Co., Cuyahoga Falls, O.
Mumford, E. H., Philadelphia.
Pangborn Company, Thomas W. New York.
Sellers, William & Co., Inc., Philadelphia.
Standard Sand & Machine Co., Cleveland.
Stockham Mfg. Co., Piqua, O.

Sand Sifters:
Deane Steam Pump Co., Holyoke, Mass.
Herman Pneumatic Machine Co., Zelienople, Pa.
Killing Molding Machine Co., Davenport, Ia.
Standard Sand & Machine Co., Cleveland.
U. S. Chaplet Supply Co., New York.

Saws (Cold Cutting):
Tabor Mfg. Co., Philadelphia.

Seacoal:
Obermayer, S. Co., Cincinnati.
Whitehead Brothers Co., New York, Providence, Buffalo.

Separators (Magnetic):
Dings Electro Magnetic Sep. Co., Milwaukee.
Elm City Engineering Co., New Haven.
Manning, Maxwell & Moore, Inc., New York.
Pangborn Company, Thomas W. New York.

Shafting (Flexible):
Stow Mfg. Co., Binghamton, N. Y.

Shovels:
Osborn Mfg. Co., Cleveland.
Stevens, F. B., Detroit.

Sprue Cutters:
Barnett. Oscar, Fdy. Co., Newark.
Brass Founders Supply Co., Newark, N. J.
Shuster, F. B., Co., New Haven.
Turner Machine Co., Philadelphia.

Stoppers:
McCullough-Dalzell Crucible Co., Pittsburg.
Ross-Tacony Crucible Co., Philadelphia.
Taylor, Robert J., Inc., Philadelphia.

Testing Machines:
Keep, W. J., Detroit.

Thermit Process:
Goldschmidt Thermit Co., New York.

Tools (Molders'):
Dobson, William, Canastota, N. Y.
Obermayer, S. Co., Cincinnati.
Paxson, J. W. Co., Philadelphia.
Peninsular Tool & Specialty Co., Detroit, Mich.

Tramrail Systems:
Moyer Tramrail Co., Harvey, Ill.

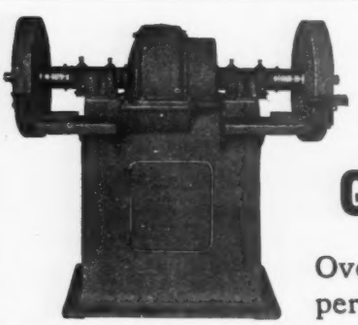
Trolleys:
Pawling & Harnischfeger, Milwaukee.

Tumbling Mills:
Adams Co., Dubuque, Ia.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Gilmour, J., New York.
Sly, W. W., Mfg. Co., Cleveland.

Turbines:
Kerr Turbine Co., Wellsville, N. Y.

Wax Wire:
Field, Alfred & Co., New York City.

Wire Straighteners:
Blake, Geo. F., Mfg. Co., New York City.
Shuster, F. B. Co., New Haven.



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Over 25 year's experience making grinders. We know how.

The Bridgeport Safety Emery Wheel Co. (Inc.)
Bridgeport, Conn.

"LOST!"

This is the despairing cry of the company's president when he picks up the yearly statement and hunts for the margin of profit.
Can *you* be certain at the beginning of the year that wrongly figured costs are not constantly eating into what now seems a good profit—and what will only appear as a *loss* one year from now, too late for remedy?

"Balance Sheet Cost Systems"

forestall all worry and enable you to know every minute just what you are doing and where you stand.
We have been installing these systems during the past four years, and they have given universal satisfaction.
"Profits *vs.* Losses"—a handsome and valuable monograph—free on request.

Edward M. Stradley & Co.
Real Estate Trust Bldg., Philadelphia, Pa.

LINDSAY CHAPLETS
W W LINDSAY & CO. — PHILADELPHIA PA.

ELECTRIC GRINDERS

960A

Especially Designed for Foundry and Machine Shop Service.
Not a Make-shift Adaptation of Ordinary Motor Construction.

Northern Dry Emery Grinder—Adjustable Speed

WE build these equipments with large crucible steel shafts which do not spring under heavy work. Speeds are especially calculated for grinding service and all parts designed to operate satisfactorily at such speeds.

Bearings are liberal and dust-proof and will not cut under heavy service. Ring oiling system assures ample lubrication.

Operating speeds of grinders carrying wheels larger than 12" in diameter are adjustable; as the wheel wears away the speed can be adjusted by field control in the motor as necessary to maintain a constant peripheral velocity, a condition essential to efficient work.

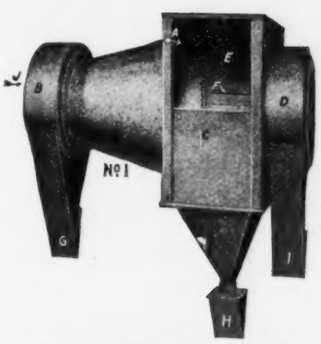
Northern grinders with their attachments are self contained. The mechanism is mounted on a hollow pedestal, the latter containing the starting rheostat and field rheostat, each outfit being wired complete.

Get Bulletin No. 1648 and tell us the diameter and face of the grinding wheels you desire to carry. We will submit prices promptly.

NORTHERN ELECTRICAL MFG. CO.,

Standard and Special Electrical Machinery

MADISON, WIS.



KNICKERBOCKER RAREFIED DUST COLLECTOR

"NOTHING REACHES THE FAN TO CUT IT OUT"—WILL LAST INDEFINITELY ON EMERY WHEELS —RATTLER—SAND BLAST.

Marshall, Mich., December 13, 1907.

The Knickerbocker Co,. Jackson, Mich.

Gentlemen:—

We have been using one of your No. 16 Rarefied Dust Collectors for several months in our cleaning department. We run several emery wheels and a rattler and clean all our castings with a sand blast. We have this Collector connected with a 40 inch Exhaust Fan and the system is working very satisfactorily indeed. The Separator seems to take out every thing that has any specific gravity at all. What little dust does go through the blower is in the form of vapor or smoke and we confidently believe our blower will last indefinitely as nothing reaches the fan to cut it out.

Should we increase our capacity, we shall certainly use another one of your Rarefied Dust Collectors.

We are, Very truly yours,

THE NEW PROCESS STEEL CO.
S. C. French, Gen. Manager.

Manufactured Exclusively by

THE KNICKERBOCKER COMPANY

Jackson, Michigan

Monarch Emery and Corundum Wheels

A corundum wheel which can be used on all plain cylindrical, universal and surface grinding machines, is one of the things with which we have been specially successful.

Made in all sizes to suit all makes of machines. Every wheel thoroughly tested before shipping.

Write for Catalogue C that shows and describes our complete line.

Monarch Emery & Corundum Wheel Co Camden, N. J.

CLASSIFIED ADVERTISEMENTS

Wanted and For Sale advertisements 40 cents a line. Positions and Help Wanted 25 cents a line. Count seven words to the line.

SUPERINTENDENT WANTED

FOUNDRY SUPERINTENDENT WANTED. Light gray iron foundry wants good man who has had long experience on small light work. Must have ability to manage complete plant. State fully age, exact experience and salary expected. Address Box 757, THE FOUNDRY, Cleveland, O.

SUPERINTENDENT WANTED FOR ORnamental and architectural iron business by established foundry. One capable of handling the entire work. Party must be able to become financially interested and willing to get in and dig. Address Box 1833, Spokane, Wash.

EXPERIENCED SUPERINTENDENT wanted for aluminum, brass and bronze foundry. Mail references with reply. Address Box 753, THE FOUNDRY, Cleveland, O.

FOUNDRY FOREMAN WANTED

FOREMAN WANTED. STEADY, HUSTling, up-to-date mechanic for five-ton ornamental and jobbing foundry. Good salary and position for right man. Apply giving full particulars to Box 776, THE FOUNDRY, Cleveland, O.

A BRIGHT, AMBITIOUS YOUNG MAN wanted as assistant foreman in a large brass foundry; brass valves, cocks and fittings for steam, water and gas. Good chance for right man. Address Box 748, THE FOUNDRY, Cleveland, O

MOLDERS WANTED

FIRST CLASS MOLDER WANTED WHO will take stock in stock company just organizing in Black Hills, old established business. Address J. C. O'Donnell, Deadwood, S. D.

SALESMAN WANTED

A STRICTLY FIRST CLASS SALESMAN wanted with an established trade and who can sell to advantage manganese and phosphor bronze to the trade in ingots or in castings. To a reliable and thoroughly competent salesman a good opportunity is offered. Give age, where employed, and salary expected. All communications will be treated confidentially. Address Box 742, THE FOUNDRY, Cleveland, O.

AN AMERICAN AGENT WANTED FOR stripping plate molding machine. Lower cost than any other machine and a capacity of 24 x 24 x 8, or 48 x 12 x 8. It is extendable. Address Arthur Green, Whittington Moore, Chesterfield, England.

HELP WANTED, MISCELLANEOUS

FOREMAN WANTED FOR ONE OF THE largest stove pattern shops in the country. Must be a man of experience in handling men in both wood and metal departments, and one able to make his own drawings and designs. Address Box 756, THE FOUNDRY, Cleveland, O.

GOOD DRAUGHTSMAN WANTED BY southern manufacturer of mine, logging and contractors' cars. State reference and experience in this line of business and advise when could begin. Salary $100.00 per month. Address "Southern," care THE FOUNDRY, Cleveland, O.

TECHNICAL OPPORTUNITIES. IF YOU are competent to fill a technical position, paying from $900 to $5,000, there are many Opportunities on our list which you ought to consider. Over 25,000 American Employers rely upon us to supply them with men, among the 1,000 technical positions now open there should be something suited to your experience. Write today for free information, and copy of Opportunities. Offices in twelve cities. HAPGOODS, 305 Broadway, N. Y., or 532 Williamson Bldg., Cleveland, Ohio.

SUPERINTENDENTS WANT POSITIONS

YOUNG MAN WITH ENGLISH AND American experience desires position as superintendent of foundry in South America. Address Box 775, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SUPERINTENDent or foreman by a practical foundryman on heavy and light gray iron castings. Well experienced on cupola and molding machines. Will furnish A-1 references. Address Box 740, THE FOUNDRY, Cleveland, O.

POSITION AS SUPERINTENDENT OR foreman wanted, in Foundry. Am 44 years of age, have had 20 years' experience in charge of Foundry producing high-grade heavy, medium and light castings with an output of 80 tons per day. Can introduce latest methods in green loam and dry sand. Well up in cupola practice and mixtures of metals. Will furnish references. Address Box 615, THE FOUNDRY, Cleveland, Ohio.

POSITION WANTED BY FOUNDRY SUperintendent with 25 years' experience on light and heavy machinery, house work of all kinds, bath tubs, lavatory and all kinds of sanitary work, fountains and general jobbing. Able to take full charge of all work pertaining to the foundry. Strictly temperate. A1 metal mixer; always handled large shops. Would prefer shop where owner wants to shift responsibility on other shoulders, after proving the same trustworthy and capable of running shop. A1 reference. Address Box 758, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SUPERINTENDent or foundry foreman by young man competent to take entire charge of gray iron foundry making light or heavy castings in green, loam or dry sand. Thoroughly versed in molding machines, cupola practice and mixing iron by analysis. Technical graduate. Age 30. References. Address Box 767, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SUPERINTENDent or manager of foundry engaged in the manufacture of chilled iron car wheels. Ten years' experience with leading concern of country. Practical knowledge of every detail including cupola practice and mixing of metals. Good executive ability and up-to-date in all methods. Married and strictly temperate. Best of references from present and past employers. Address Box 734, THE FOUNDRY, Cleveland, O.

POSITION WANTED ON ARCHITECtural and ornamental iron work. Superintendent seeks a change. Experienced in all departments. Expert patternmaker, modern foundry practice, molding machines, cupola and mixture of metals, brass and bronze. Up-to-date on finishing shop methods. Can handle work from start to finish. Will furnish first-class references. Address Box 772, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SUPERINTENDent or foreman with a good firm by a thorough foundryman of 20 years' experience on light and medium weight castings. Address Box 762, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SUPERINTENDent or foreman in a stove foundry, by an experienced, practical man. References supplied as to reliability, habits, etc. Would consider a proposition for an investment to secure permanency. Address Box 777, THE FOUNDRY, Cleveland, O.

FOREMANSHIP WANTED

FOREMANSHIP WANTED OF SMALL jobbing foundry, making castings from 1 pound to 2 tons. Can make any common pattern; handy with tools. Also run lathe or planer to good advantage; 18 years' foundry practice, 7 years as foreman, age 32, married. South preferred, references. Address Box 718, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman in gray iron foundry. 20 years' experience in modern foundry practice. Good metal mixer and have had good cupola practice. Can handle green sand, dry sand or loam work. 7 years foreman. Good reference. Address Box 770, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOREMAN IN foundry making light and medium gray iron castings by an experienced man 37 years of age. 20 years' experience on jobbing and agricultural castings. Up-to-date in cupola practice, mixing iron and handling help and molding machines. Can furnish references. Employed at present, but would like a change. Middle west preferred. Address Box 763, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOREMAN IN brass foundry making valves, cocks and fittings for steam, water and gas. Thoroughly understands the mixing of metals. Familiar with oil furnaces and molding machines. Twenty-one years with one company; five years of that time as foreman. Can give A1 references. Strictly temperate and reliable. Address Box 764, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman or assistant. Fifteen years' experience, light and medium weight work. Business education. 35 years old; married. First class references as to character and ability. Address Box 755, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY BRASS FOUNdry foreman, on special or jobbing work. Thoroughly understands the alloying of metals and can guarantee results. References given. Address Box 768, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY FOUNDRY foreman, who has had a wide experience in gray iron and steel. No objection to open or non-union shop. Can furnish the best of references as to character and ability. Address Box 774, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS FOUNDRY foreman. Well experienced in light and medium gray iron cupola practice and molding machines. References from last employers. Open shop preferred. Address Box 766, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY AN UP-TOdate foundry foreman. Wanted to correspond with firms who are in need of a strictly first-class mechanic. Fully experienced in all classes of heavy and small work, in loam, dry and green sand, and perfect at all core work. Understands handling of men to best advantage, and wanted to handle a large plant. References are the best. Open for position first of April. Open shop preferred. Address Box 773, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY FOUNDRY Foreman. Practical man or architectural, ornamental, iron and bronze work. Can produce high grade castings in this line of work at minimum cost. Address Box 771, THE FOUNDRY, Cleveland, Ohio.

POSITION WANTED WITH SOME GOOD reliable firm by an A1 foundry foreman. Can furnish first class reference. Address Box 761, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY A1 FOUNDRY man who will be at liberty shortly. Well versed in modern foundry practice and gray iron jobbing. Boiler and radiator work preferred. Correspondence solicited. Address Box 759, THE FOUNDRY, Cleveland, O.

POSITION WANTED BY PRACTICAL man, 25 years' experience on all class machinery and jobbing; sober, reliable and energetic. References. Address Box 746, THE FOUNDRY, Cleveland, O.

POSITIONS WANTED, MISCELLANEOUS

POSITION WANTED AS FACTORY ACcountant by practical man on machine shop and foundry costs, also first class bookkeeper and systematizer, with manufacturing concern. Modern methods and satisfactory results guaranteed. Address Box 735, THE FOUNDRY, Cleveland, O.

POSITION WANTED AS SALESEMAN for a malleable iron works. Have had practical experience as superintendent and am competent to figure on work and make correct prices. Address Box 754, THE FOUNDRY, Cleveland, O.

CHEMIST AND METALLURGIST DESIRES change. Several years' experience in both gray and malleable iron work. Thoroughly familiar with foundry practice, costs, etc. Good executive. Highest references. Address Box 765, THE FOUNDRY, Cleveland, O.

BUSINESS OPPORTUNITIES

INVENTORS ATTENTION: MERITORIOUS patented foundry machinery manufactured on royalty basis. Long experience and unexcelled facilities for reaching foundry trade. Whiting Foundry Equipment Company, Harvey (Chicago Suburb), Ill.

NEW CONCRETE AND BRICK ONE-story factory building and 30-acre site ready for occupying suitable for foundry, hardware, engine or machine works, are offered for 65 cents on the dollar. Ideal location on Lake Shore Railway and Lake Erie at Port Clinton, Ohio. For further information address Wm. B. Knight, Port Clinton, Ohio.

PROPERTY FOR SALE

FOUNDRY AND MACHINE SHOP FOR sale or rent. Located in the heart of the newly discovered oil fields of Idaho. Address L. E. Waters, Weiser, Idaho.

BLOWERS FOR SALE

BLOWER BARGAINS.
Roots Second-Hand Blowers, bought, sold, or exchanged for new ones. Address,
H. M. PAPWORTH.
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ONE CONNERSVILLE BLOWER FOR sale; capacity 33 cubic feet per revolution; five-foot pulley. In use one year. First class condition. Address Schipper & Block, Peoria, Ill.

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TWO SECOND-HAND CUPOLAS IN first-class condition. Shells 72"-82" in diameter and about 40 feet high. Box 800, THE FOUNDRY, Cleveland, O.

MOLDING MACHINES FOR SALE

TWO ARCADE MOLDING MACHINES **for sale at a sacrifice. Acme Steel & Malleable Iron Works, Buffalo, N. Y.**

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SECOND HAND GOODS FOR SALE.
1 Sellers's Centrifugal Sand Mixer.
1 36 x 48 Tumbling Barrel C. I.
1 Portable Millet Core Oven.
1 Tripod Pneumatic Sifter.
3 McKenna Molding Machines and Flasks.
1 1200-lb. Cap. Sulky Ladle.
27 Brass Foundry Furnaces, assorted.
1 54-in. Crandall Cupola.
1 No. 4 Baker blower.
15 16 x 16 x 3 in. Cope and 2 in. Drag Barnet Iron Flasks.
J. W. Paxson Co., Philadelphia, Pa.

PULLEY EQUIPMENT FOR SALE, IMmediate delivery. Write us. Royersford Foundry & Machine Co., Royersford, Pa.

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SECOND HAND SCHWARTZ FURNACE wanted. Capacity 1,000 lbs. Must be in good condition. Address Box 769, THE FOUNDRY, Cleveland, O.

FOUNDRY EQUIPMENT WANTED

SECOND-HAND FOUNDRY EQUIPMENT wanted, including Cupolas, Ladles, Tumbling Barrels, etc. Quote price and state condition. Address Box 885, THE FOUNDRY, Cleveland, Ohio.

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FOUNDRY SPECIALIST. IF YOU HAVE trouble with your iron call on us. We have a specialist we send out who we know is fully capable of adjusting your difficulties and in a very short time. It will pay you well to consult with us when in trouble. A. Buch's Sons Co., Elizabethtown, Pa.

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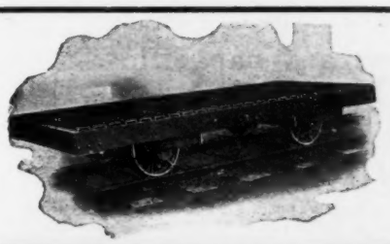
FLUOR SPAR.—EVERY GRADE. QUOtations delivered anywhere. Cheapest suppliers. Address GEO. G. BLACKWELL SONS & CO., Ltd., Liverpool, Eng., or Agents, Penna. Salt Mfg. Co., Pittsburg, Pa.

FLUOR SPAR—BY THE BARREL, TON or car lots. Address American Fluor Spar Co., Paducah, Ky.



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We have in stock for immediate delivery a number of Flat Core Oven Cars which we are offering at a very low price.

Complete data furnished on application.

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OUR **MOLDERS' TOOLS**
are perfect in shape, "hang," temper and finish
Your Molders should be as well equipped with tools as your foundry
Help them secure ours

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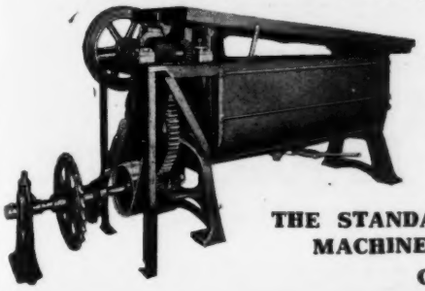

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Peninsular Molders' Tools
are the best in
Quality, Finish and Temper.
Made by the
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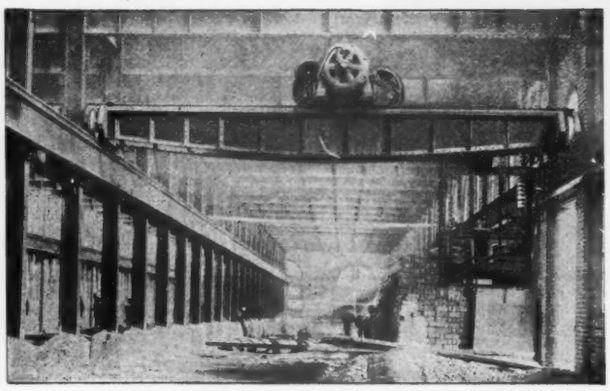

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We make only the highest grade cranes. A wide variety but only one quality —the best.

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All types and capacities.

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All Types and Sizes for all Purposes.

Dependability

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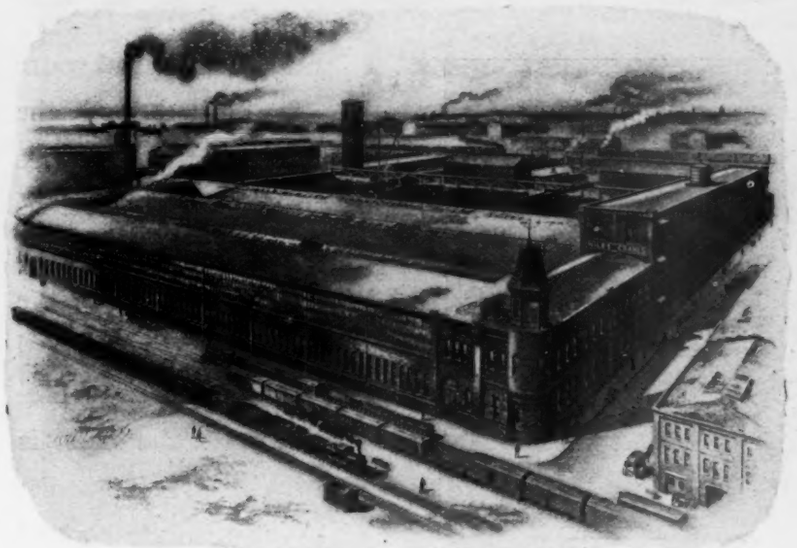

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Meadow and Mifflin Sts., Philadelphia, Pa.

The view shown of our Crane Works gives an idea of the great size of this plant, which is equipped throughout with the latest and most improved machinery.

Our ample facilities, together with the fact that all the various component parts of Niles Cranes are made to standards, enable us to offer prompt deliveries.

Write for new catalogue "Niles Cranes"

NILES-BEMENT-POND COMPANY, 111 Broadway, NEW YORK

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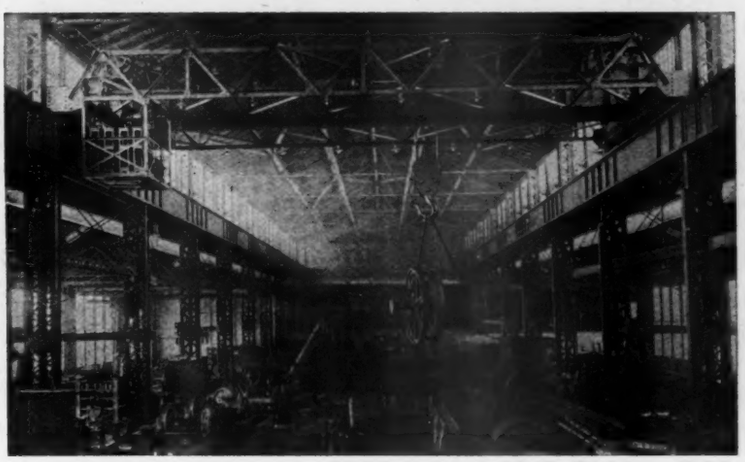
BROWNHOIST



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"Brownhoist" Traveling Cranes are Cranes of Quality. If efficiency, low power consumption and durability are first considerations, we are sure we can meet your views.

The Brown Hoisting Machinery Company

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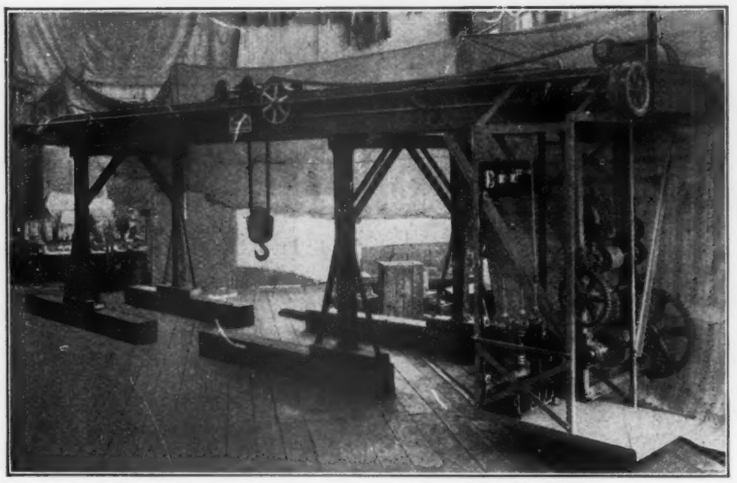
Branch Offices: New York and Pittsburg.

Engineers, designers and manufacturers of all kinds of hoisting machinery.

Foundry Crane



WHERE the head room is limited and the ladle of hot metal comes close up to the bridge, it is desirable to keep the hoist and motor away from the heat. In addition to the usual automatic electric and mechanical brakes the hoist is provided with a hand brake which gives absolute control of the lifting speed from full speed with a full load, to a few inches a minute for drawing patterns.

MARIS BROS., - Philadelphia, Pa.

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50 TON 4 MOTOR STEEL FOUNDRY CRANE

SHEPARD CRANES ARE IMMUNE FROM DIRT.

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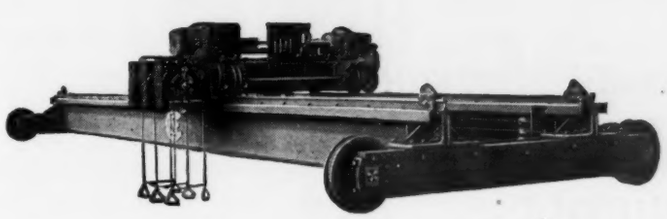

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A. C. or D. C.
MOTORS.

THE CASE MFG. CO., **COLUMBUS, OHIO.**

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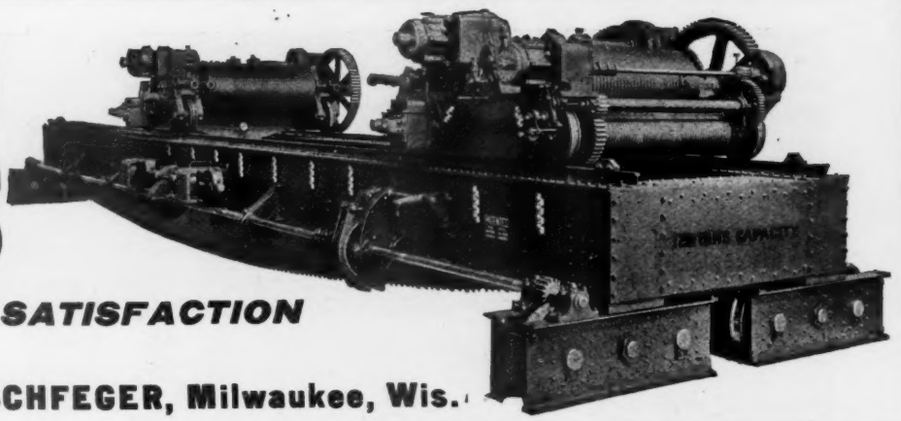

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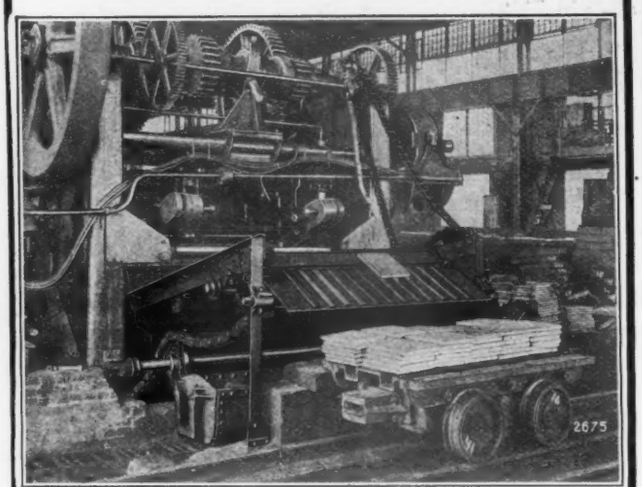
PAWLING & HARNISCHFEGER, Milwaukee, Wis.

Billet Conveyor



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STEELE-HARVEY Brass Bronze Aluminum CRUCIBLE OIL Melting Furnace SLY Steel Exhaust Cleaning Mills Dust Arresters Iron and Brass Cinder Mills

NEW ENGLAND ENGINEERING & EQUIPMENT COMPANY, Weld Building, BOSTON, MASS.

The Moyer Tramrail System

FIG. 5—TRAMRAIL LAYOUT IN FRONT OF THE CUPOLAS

¶Now then, Mr. Foundryman,

¶We want you to put your time against ours.

¶We want you to send us a plan of your foundry, drawn to scale, showing the cupola, the girders, the molding floors, the distance from the foundry floor to the underside of the girders; show the position of your core ovens and your rumblers.

¶And tell us whether carrying metal or sand, or cores, or flasks, or all four appeals to you most.

¶Then **we** will make up a detailed working plan of your foundry, showing the "MOYER TRAMRAIL SYSTEM" installed.

¶We will tell you how it can be installed.

¶We will tell you what the **"System"** will cost you f. o. b. your city.

¶We'll tell you just where the "System" will save for you.

¶And how much it will save—and why.

¶It will cost you very little to send such a plan.

¶The quicker the "MOYER TRAMRAIL SYSTEM" begins to work for you, the quicker the savings will pile up. So, better send the plan along today. It's up to you now. We're ready.

FIG. 6—RACKS FOR HANDLING CORES

¶We have just published Bulletin No. 102 showing actual photographs of the Moyer Tramrail System for Foundry use EXCLUSIVELY.

¶The book shows just how pig, coke and scrap can be carried to the CHARGING FLOOR.

¶How the HOT METAL and CORES are carried to the MOLDERS.

¶How the FINISHED CASTINGS go to the rumblers, to the grinders, to the stock bins.

¶"102" shows the CHEAPEST method known of handling both BRASS and IRON, and a lot of other things of interest to the Foundry Trade.

¶We'll be glad to send you a copy of the bulletin if you will write us on your LETTER HEAD, just say—

"Let Bulletin No. 102 come along."

¶We'll know what to do.

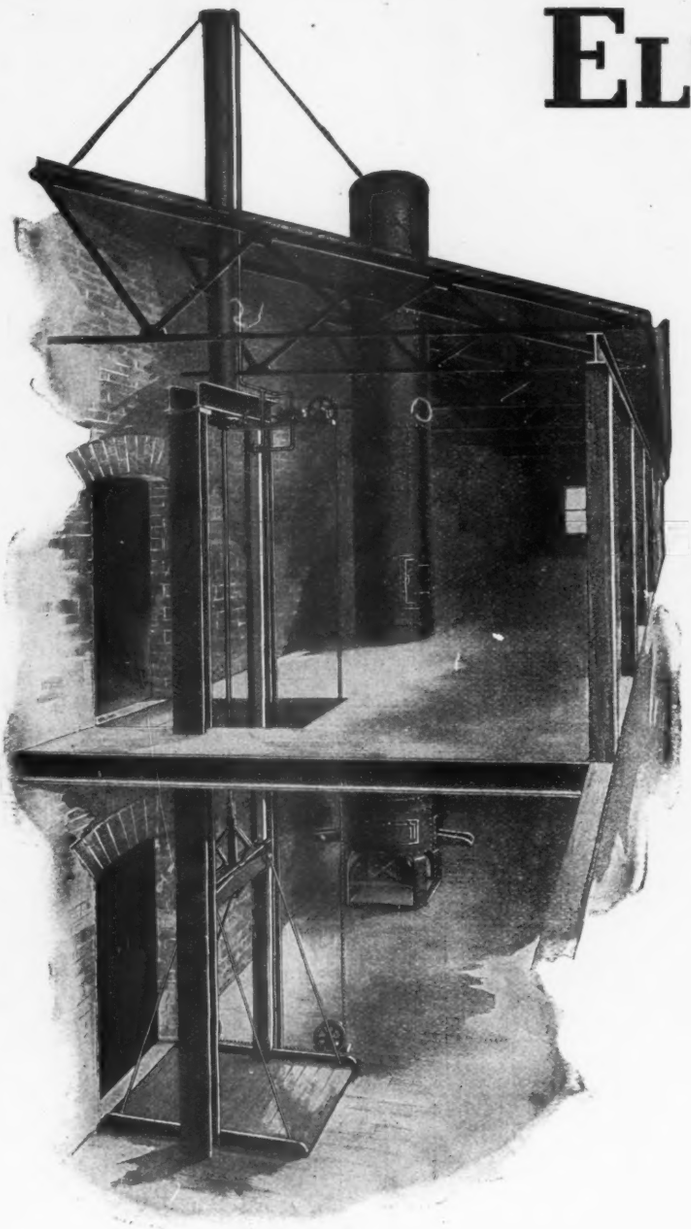
MOYER
Tramrail Co.

P. O. Box 212

Harvey, Ill,

(Chicago Suburb)

PNEUMATIC FOUNDRY ELEVATORS



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